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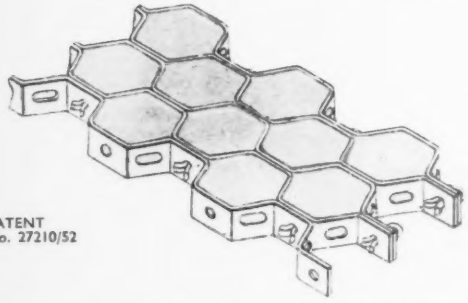

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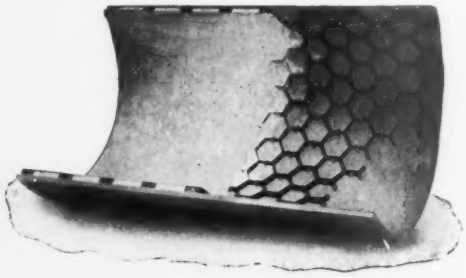

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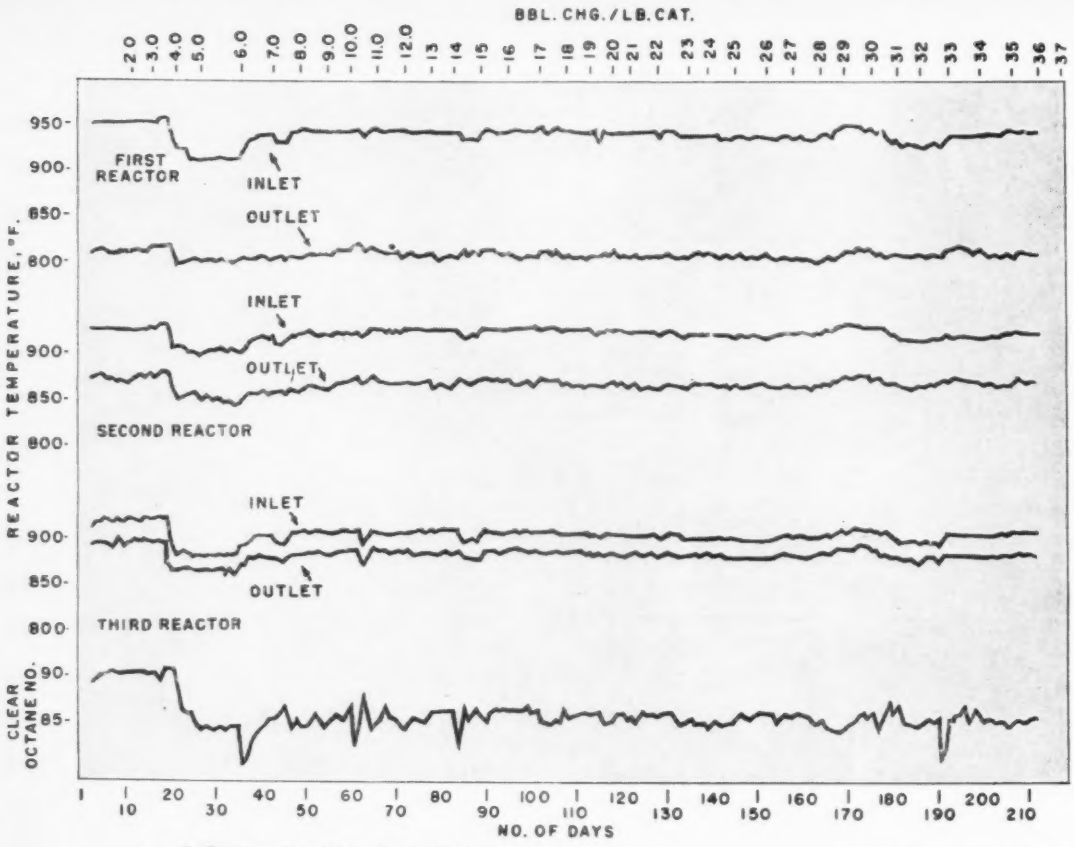

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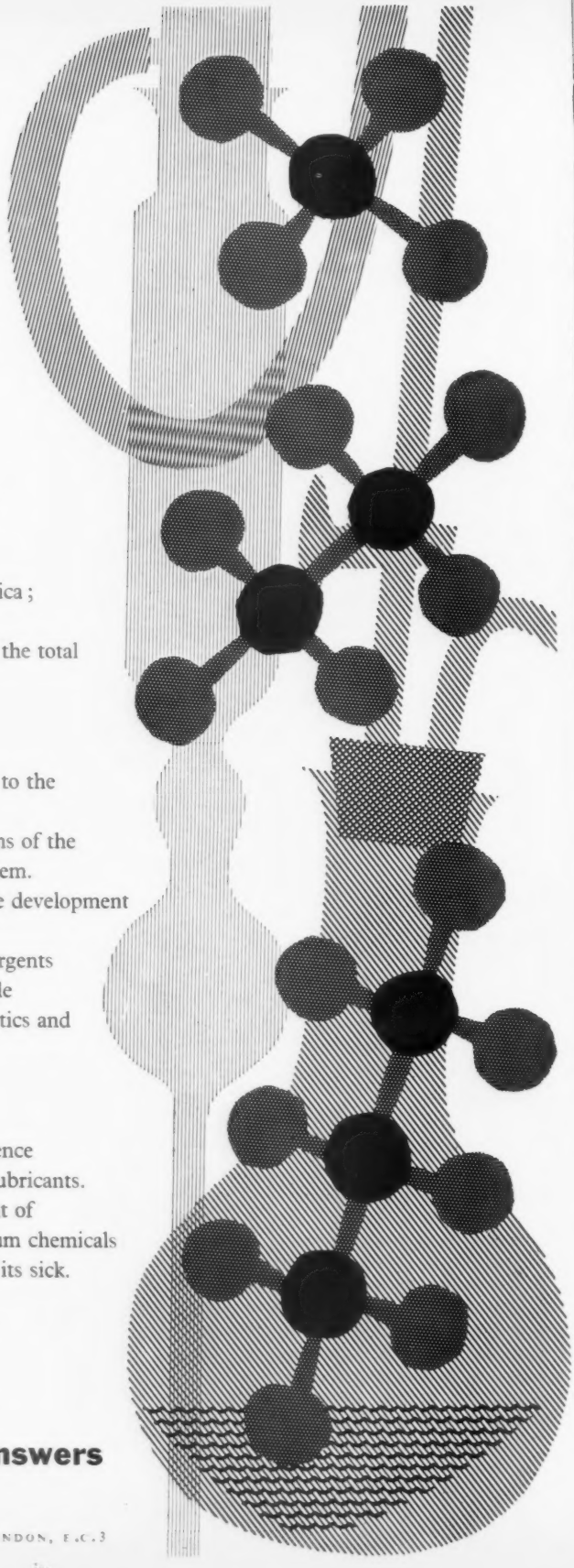

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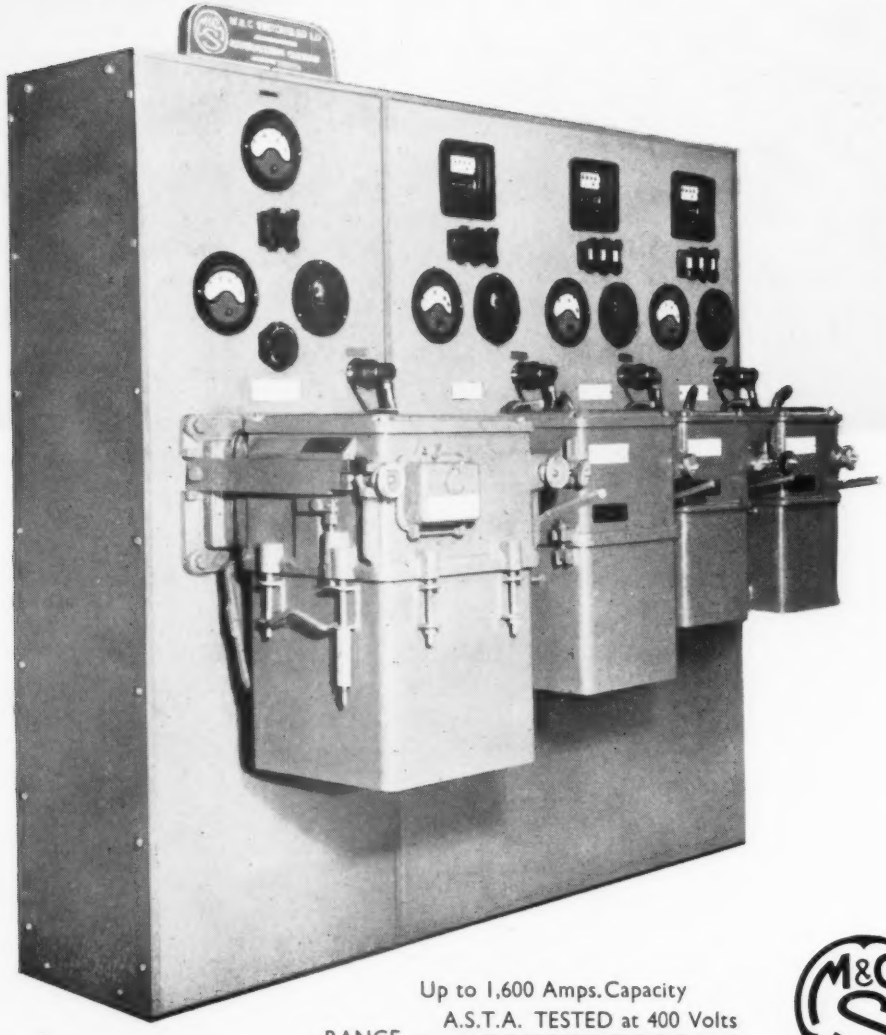

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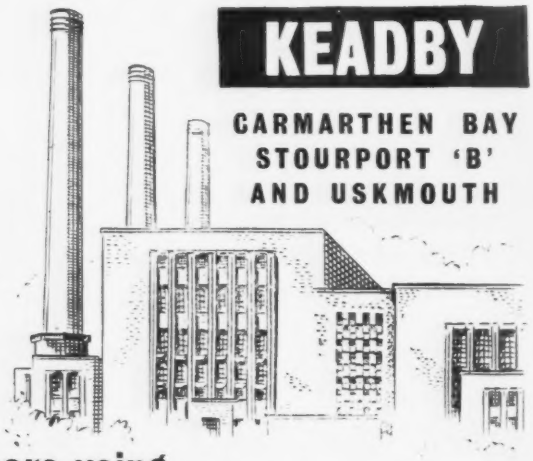

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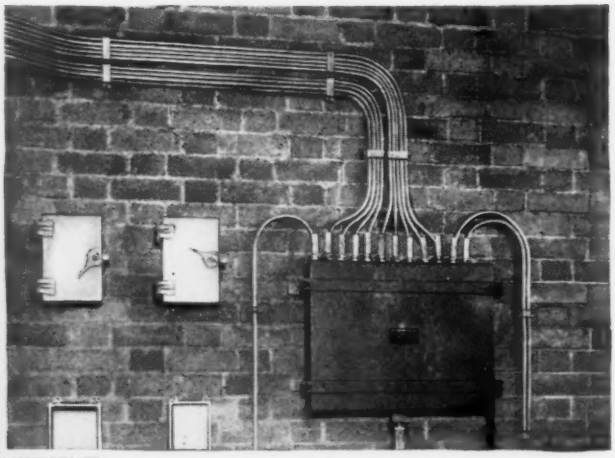

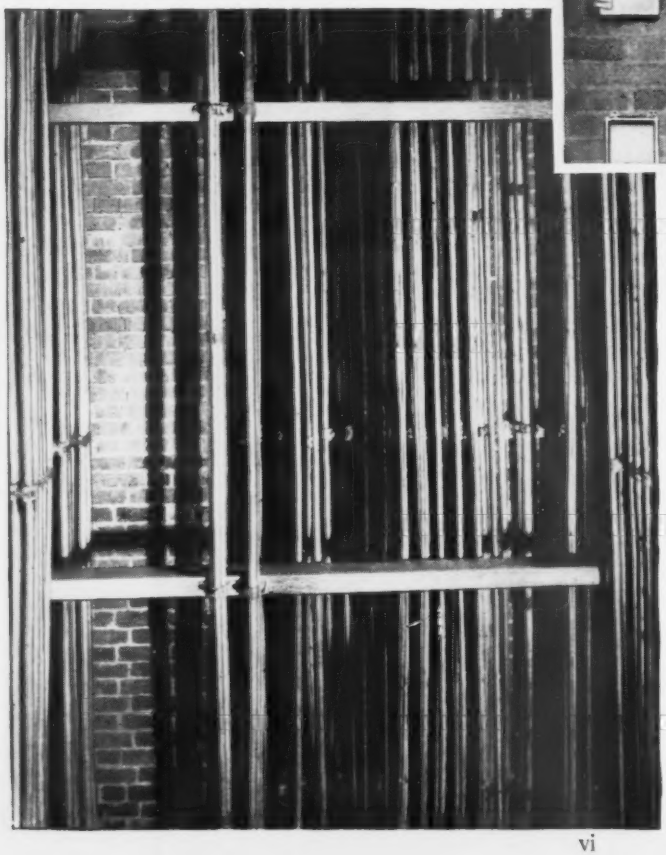

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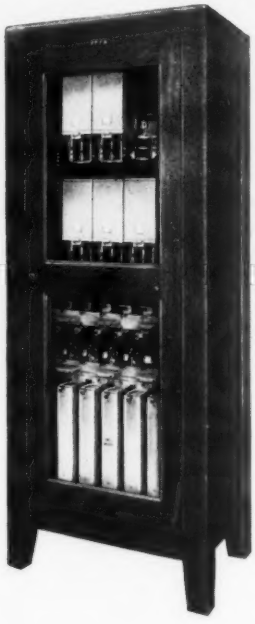

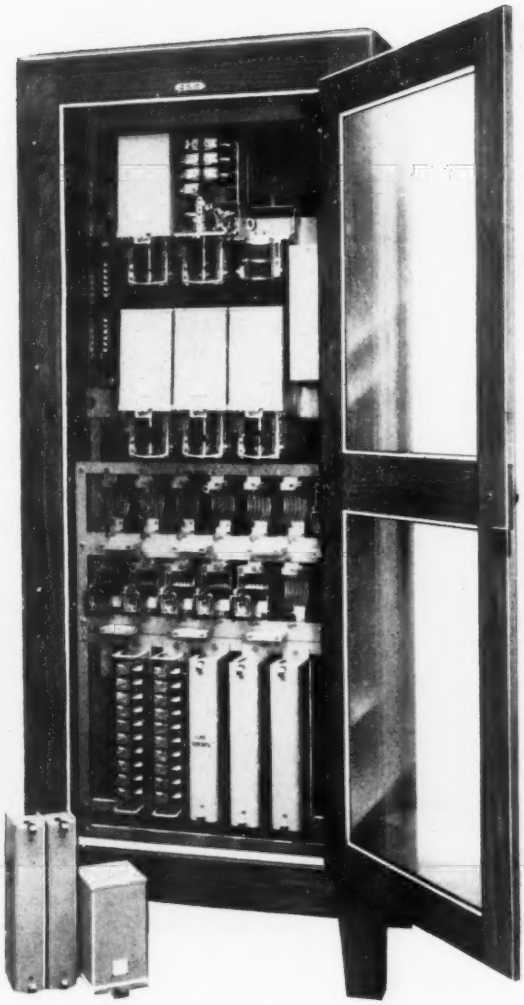

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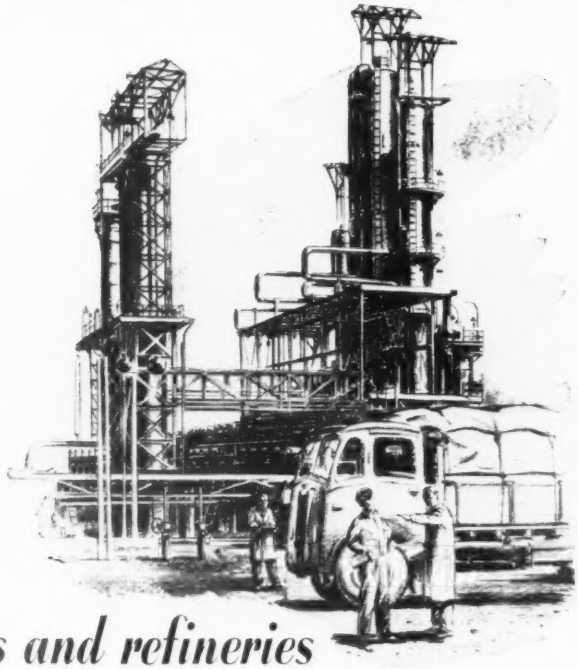

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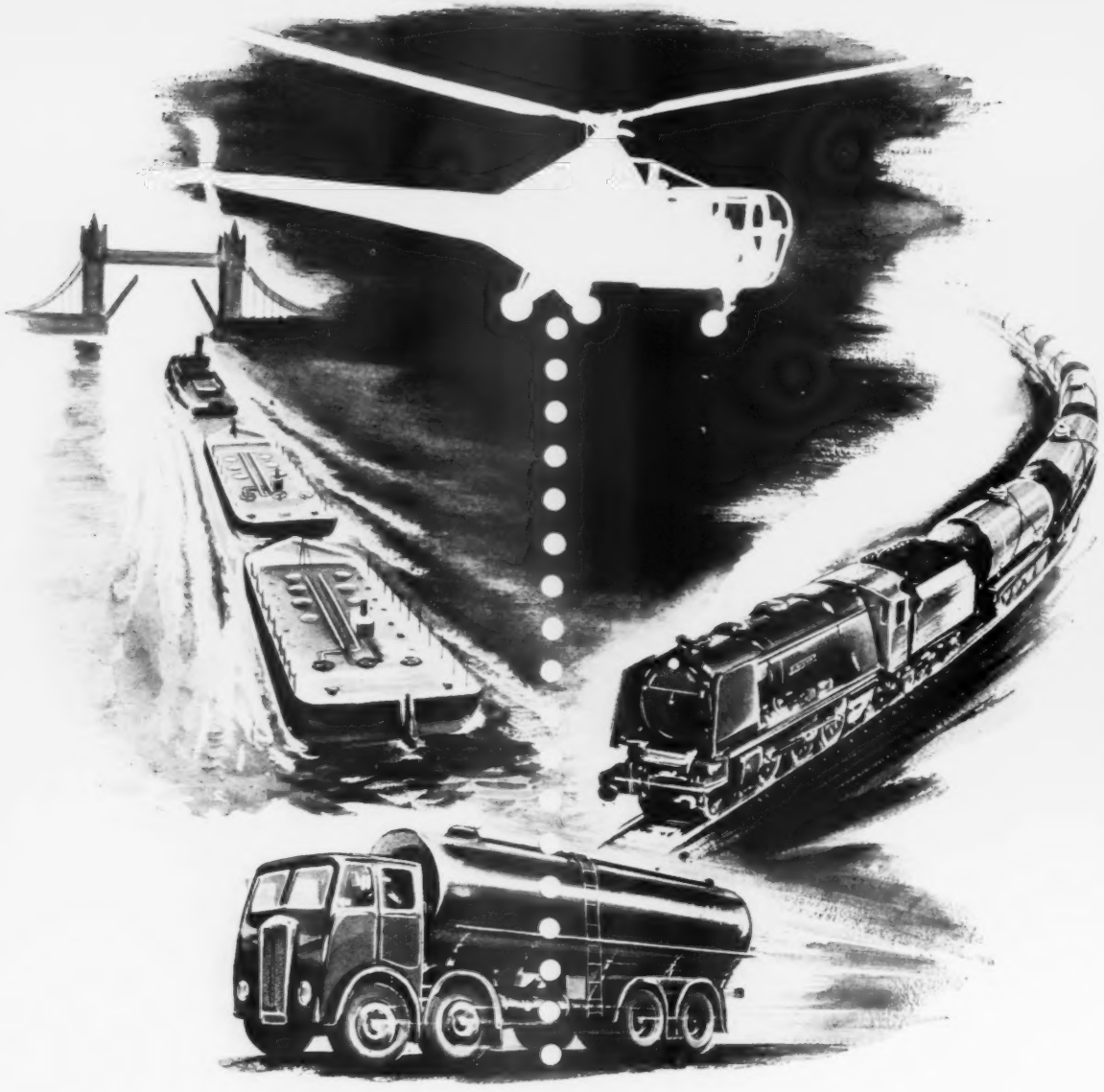

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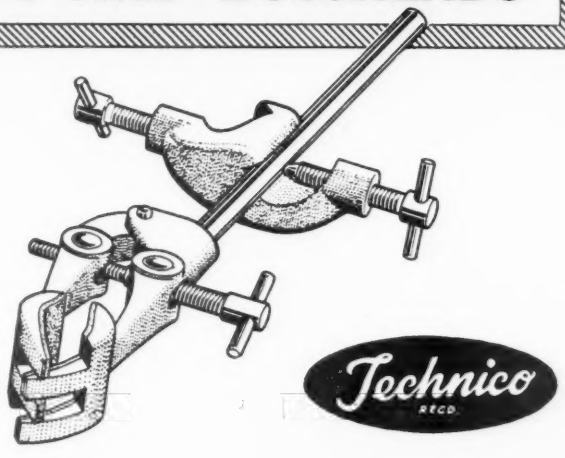

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Llandarcy Autofiner, South Wales. Photo by courtesy of The British Petroleum Co., Ltd.

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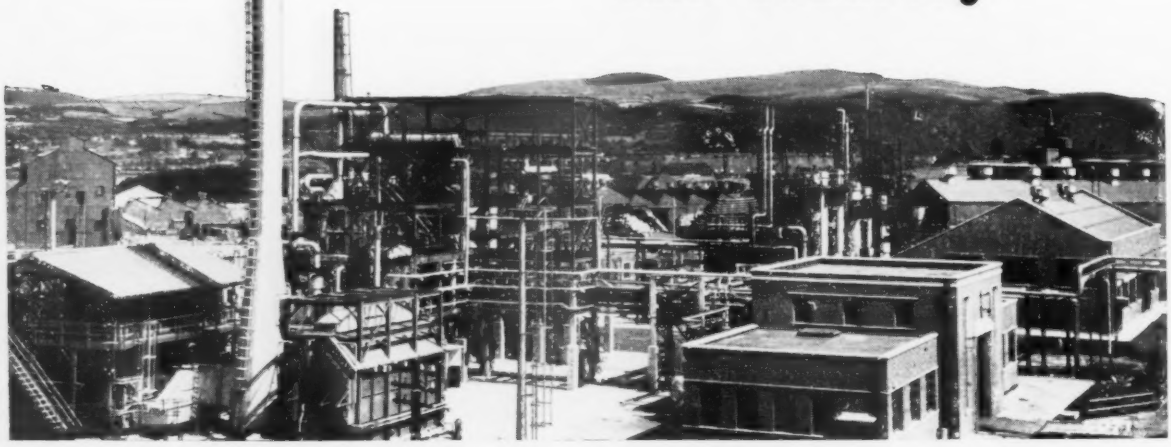

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A Physicist in the Oilfields

By Dr T. F. GASKELL*

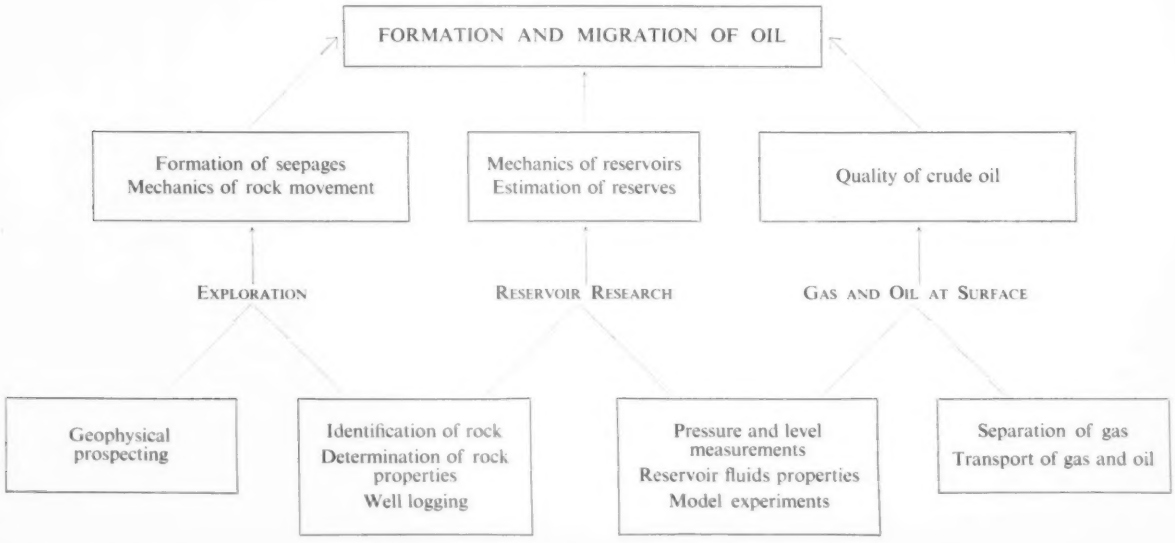
One does not often meet an oilfield physicist, for although the applications of physics in an oilfield are many and varied, there is a tendency to dub the field man an "engineer" of one sort or another, or to pass physics problems back to headquarters or to a research institution, or to call in specialist service teams to collect information and supply advice. It is natural that small oilfields should not carry a physicist, and it is in the large limestone fields of the Middle East, somewhat inaccessible as far as experts are concerned, that the all-in-one scientist, with a keen appreciation of the laws of classical physics and a close interest in practical operations, is to be found. The wide range of physical problems extends from geology, which is perhaps the least quantitative of the sciences, to mechanical engineering at the very practical end of the scale. In between comes instrumentation for measuring the physical properties of oil reservoirs, the physical-chemistry of oil and gas mixtures, and transmission of fluids down pipelines. The oilfield physicist must make a happy balance between research and the provision of definite answers, in fact the work is reminiscent of war-time naval research, when the various new enemy devices were combated by a combination of scientific knowledge, ingenious experiments, and above all, speed in producing an adequate, albeit not one-hundred per cent perfect, result. Most of the problems associated with an oilfield require the type of physics which was formulated in the 19th century, and a great many of them can be solved by good reasoning followed by check experiments in the laboratory, plus a certain amount of routine collection of facts. Of course, the great advances of the 20th century make the instrumentation of measurements immensely easier than it would have been in the past, and in some cases allow experiments that would have been impossible even twenty years ago, so that the field physicist must be well abreast of all modern work in his subject. Furthermore, our physicist must be capable of explaining his findings to those who run the oilfields. Just as in war-time, when a close liaison between scientist and naval officer was essential for a proper understanding of the true problems on the one hand and a correct use of new devices on the other, so the field physicist must be practical-minded enough to decide what is required and not too aloof to talk intelligibly to his non-scientifically trained colleagues.

* The British Petroleum Co. Ltd.

Geological Problems

The physicist enters the oilfield scene almost at the beginning, for modern exploration is much dependent on the geophysical methods of locating potential underground oil reserves. Although geophysical work is undertaken by specialized units operating from headquarters, the discussion of results, the location of sites for bore-holes, and the programme of survey work to be carried out, is largely the responsibility of those in the fields, and the resident physicist can often be of assistance to geologists in explaining, for example, the limitation of gravity and seismic methods, in advising which of the standard methods or modifications of these will be most likely to find the geological knowledge desired, and in pointing out the difference between incontrovertible fact and a likely interpretation of the results of geophysical experiment.

Geologists sometimes require to know the mechanism by which certain folds in the rock layers have been formed. The finished article, for example, a hill or mountain on the surface, is open for inspection, and a careful examination of the visible features of the oilfield area, combined with ideas of underground structure obtained by drilling, allows theories to be formulated as to what has happened in the past to cause the present state of affairs. Everything happens very slowly in geology, however, and it is useful to confirm hypotheses by ensuring that they are compatible with the known laws of physics and the properties of the rock. In the Middle East plugs of salt look as if they are being squeezed out of the earth, and the equivalent of a slowly moving glacier of



The inter-relation of physics problems in the oilfield.

rock-salt gives support to the idea that the salt layer is mobile. The amount of mobility that can be allowed determines the manner in which the salt and its adjacent layers move, and therefore the probability or otherwise of various underground structures that may be postulated. Furthermore, the physical mechanisms of formation of reservoirs help to elucidate the course of the migration of the oil before it arrived at its final resting place. One of the long-term aspects of physics

Preparing rock specimens for examination under the microscope.

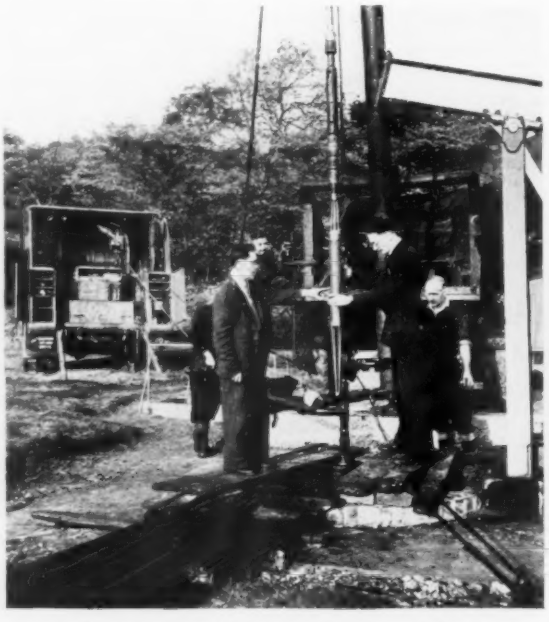
research in oilfields is the study of the formation of oil and its subsequent movement, and both geological theories and the physical knowledge that is collected about the oil and its environment lead ultimately to a better understanding of these phenomena. It is convenient and scientifically interesting to maintain this academic target of finding out how nature produced oil, in order to provide the field physicist with something other than short-term research work, and to co-ordinate all the odd items of work that the physicist does. As with most academic scientific problems there will undoubtedly be a reward when the mechanisms of oil formation and movement have been discovered, not only in guiding the explorer to new oilfields, but also in forecasting what quality of crude oil is likely to be found in a given area. Fundamental research work usually pays a good dividend, and the central position of an oilfield physicist amongst the various lines of evidence that are available from the other sciences, makes this specific research problem a most suitable one.

Oilfield geologists are not only concerned with finding new oilfields. A large amount of laboratory time is spent in identifying the layers of rock that are penetrated during the drilling of an oil well. In large Middle East limestone fields adequate identification follows inspection of the small chippings of rock produced by the drill. The minute fossils which can be seen under the microscope change character from one part of the rock column to another and can be used as reliable markers of position in the geological sequence or rock layers. It is therefore not necessary to delay drilling in order to collect long lengths of rock core, as must be done in oilfields where production is from thin sands which are too friable to yield small chippings which have character.

Examination of rock chippings is not confined to geological identification. The colour of the chippings, and also the colouring produced in a solvent used to extract all traces of oil from the rock, both give indications of the amount of oil contained in the rock down below. Physical measurements based on the darkness of the extracting liquid, combined with measurements based on the colours of various crude oils, avoid mistakes made by merely visual observation and allow meaningful numbers to be allotted to various amounts of oil-staining of rock. In addition to assisting the geologist with measurements of the amount of oil contained in the rock, the physicist can add considerably to the knowledge of what is the maximum quantity of oil that rocks of various sorts can hold. Measurement of the porosity of rock specimens shows what is the total empty space available to hold fluids (water, oil, or gas), and by measuring the size of the actual pores in the rock a knowledge of how much of the oil is recoverable may be obtained.

Reservoir Engineering

The study of the mechanism of production of oil and gas from beneath the ground is the main province of the oilfield physicist. Although the work is performed by petroleum engineers, the training necessary for this type of career is much more scientific than engineering in nature. Some petroleum engineers have admittedly a background of engineering, some are physical chemists or mathematicians in the beginning, but the measurements they make, and the deductions they draw from these measurements, are definitely more concerned with experimental physics than with mechanical engineering. The petroleum engineer (for it is so well established a title that it is unreasonable to alter it to physicist) advises the production department on what off-take of oil is permissible without damage to the oil reservoir; he decides how many producing wells are needed to achieve a certain off-take in a field; he collects facts about the working of the underground reservoirs of oil which enable him to assess the merits of various schemes to increase the ultimate total oil recovery; he is the calculator of the reserves in the oilfields, and is also the watch-dog on the quality of the crude oil that is sent to the refinery. In addition to all these operating problems, the petroleum engineer joins the exploration team in testing a bore-hole to see whether it will produce oil. In the large fields of the Middle East the production is generally fairly obvious because large quantities of oil and gas are produced by one well, and pushed to the surface by considerable excess underground pressure. However, it is necessary at times to test limited sections of the rock separately and the bore-hole is divided up by special rubber "packers" which



Finding properties of the rock in situ*—well-logging.*

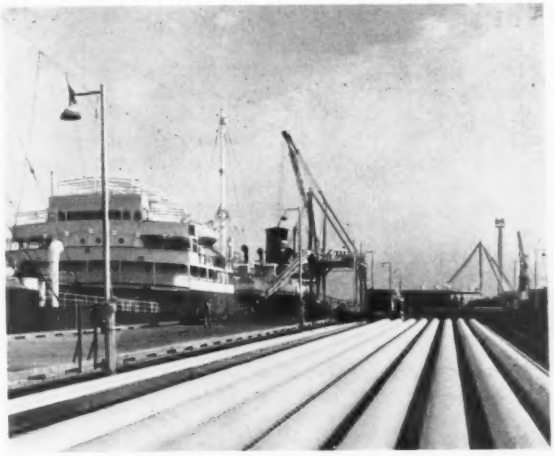
enable the liquids and their pressures from only one rock layer to be examined. This type of test gives supplementary knowledge to the detailed examination of pore size of the reservoir rock, which has already been mentioned.

Just as geological interpretation has been developed to operate successfully with chippings of rock, in order to save drilling time, so also has the detailed examination of pore size distribution been adapted to work without rock-cores. Electrical and other special logging methods, in which changes of rock properties down a bore-hole are measured by lowering continuously recording instruments, allow the geological and physical assessments of changes in rock types to be checked, and in some cases extended over portions of the hole where the return of rock chippings has been sparse, or the recorded depths during drilling have been in error. Furthermore, the logging devices allow correlation from one bore-hole to another, and in many cases may be used to extend detailed pore-size knowledge from one bore-hole to other parts of the oilfield.

While the laboratory measurements of pore-size and their extension over the whole oilfield can be used to calculate the quantity of oil in the reservoir and also how much is recoverable, it is of course necessary in operating a field to determine the rates of movement of oil-level and water-level, and the pressure changes in the oil and gas mixture that is contained in the rock. It is in fact possible to forecast reserves and the amount of recoverable oil by making these latter types of measurement alone, and a great deal of routine observation, and the necessary instrumentation required to carry this out, form a large part of the petroleum engineer's daily work. The calculations that are made on the behaviour of oil and gas in underground reservoirs require certain laboratory experiments which may be of model type, such as direct observation of the oil pushed out of a piece of rock saturated with a gas and oil mixture under pressure, the flushing of oil from a piece of rock by water, or measurement of physical properties, for example, viscosity and surface tension of reservoir fluids under conditions pertaining underground. Full-scale checks of the reservoir calculation may be made by observing what happens to gas pressures and oil and water levels when an oilfield is shut down, or when large changes are made in production rate from the field. In large limestone

Separation of oil and gas—multi-stage unit.

fields of the Middle East the system of fissures in the rock allows such good connexion between wells miles apart, that overall calculations of behaviour may be made with some certainty, the chief unknown being the size and spacing of the fissures in the volume of rock that constitutes the oil reservoir. For example, if fissures are widely spaced, a slow drainage of oil from the gas-dome area of a field will take place into the oil zone below, and will manifest itself as a rise in oil-level without an accompanying pressure rise, while if a large proportion of the oil brought to the surface is being driven out by water rising from below the oil, then both oil and water level will rise with a consequent increase in gas pressure when a field is shut down. Direct evidence of fissures may be



Where field work ends—delivering crude to a tanker.

obtained by measurements of losses of mud during drilling and by observing the flow of oil from a well at different levels, but there is no doubt that a good average valuation can also be made by checks between forecasts of how levels and pressures should change and what happens in practice. As a corollary, of course, the petroleum engineer should aim to understand his field in such a way that his forecasts are substantially correct.

Oil and Gas at the Surface

The mixture of oil and gas that reaches the surface of the ground from the oil wells has its own special problems. The refinery deals with crude oil at approximately atmospheric pressure, partly because the distillation system is designed that way, but also because carriage of crude by tanker and storage in flow tanks have to be at normal pressures and temperatures. In order to avoid loss of valuable products, such as butane, which are on the border-line between liquid and gas it is necessary to carry out a form of distillation at the oilfield. The gas is separated from the oil in a series of pressure vessels, the pressure of each vessel being less than that of the previous one. The optimum pressures for each stage of this multi-stage process must be calculated and it is the oilfield physicist who normally provides these figures for the production department. The calculations require a knowledge of the relative amounts of methane, ethane, etc. in the gas-oil mixture, and these are determined in the field laboratory, together with the amounts of undesirable gases such as hydrogen sulphide, which cause the "sour crudes" so detested by some refineries, and small traces of compounds that may provide clues as to the origin of oil. The gas takes away most of the small percentage of water that comes up from the reservoir with the crude oil, and if the gas is to be transported over land in cold weather it is important to know the exact amount of water, because under pressure a solid compound of gas and water called a hydrate may be formed and this may block the pipe. It may be necessary to

remove some of the water, or to operate at a lower pressure in order to avoid this. Pipeline problems occur also in the transport of crude oil. When pipelines are laid down above the ground large temperature changes occur owing to direct heating by the sun during the day, and in order to avoid loss of the light constituents of the crude, which have been so carefully preserved at the oilfield, it may be desirable to cool the oil before discharging into a storage tank or a tanker.

Operational Research

The technique of using to the best advantage the materials available, and of putting numbers to plans and ideas in order to assess their chances of success, was used during the war, and it achieved a certain distinction and the title of operational research. The physicist is the operational research expert in the oilfields, not only because his training enables him to give an impartial appraisal of various schemes put forward, but also because he has at his finger-tips most of the factual evidence which is needed for the job. This does not mean that the physicist is the arbiter of all suggested improvements in operating an oilfield. All competent technical men use the principles of operational research in formulating new proposals, but the scientific method of putting numbers to a problem assists in avoiding biased opinions, and in forecasting to a fair degree of accuracy what are the consequences of any change. For example, we could imagine a set of circumstances where good quality oil is obtained from field A, while from its neighbour B the crude contains a high proportion of less valuable sulphurous residue. A topping plant at A allows adjustment to market requirements, by removing the light portion of the crude and returning the residue to be recycled to the reservoir to collect more light ends from the gas-dome of the reservoir. The topping plant would be more sensibly placed at field B, because if anything is to be rejuvenated let it be the poorer quality material. Again, heat exchangers may be used to cool the gas and oil mixture from the well-head before it passes through the multi-stage gas separation system. This is rather like having belt and braces, because the multi-stage separation conserves the optimum amount of light fraction in any case. However, force of circumstances may make it necessary to separate some gas from the crude oil in a single operation, and in this case the preliminary cooling by heat exchangers would provide stabilized oil of improved quality. Since oilfields necessarily grow rapidly, and *ad hoc* improvisations have to be made, it is necessary that an enquiring mind should ask at intervals why certain things are done. However, no calculations can be cleverer than their basic ingredients, and the considerations that control many oilfield decisions may be associated with the economics of marketing as much as with the possibilities of engineering. It behoves the physicist, then, in his practical oilfield rôle, to interest himself in all aspects of the oil business, so that while he is chiefly a guardian of the efficient operation of his oilfield, he can at the same time talk sensibly about the impact of his products on the refineries and the outside world.

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Problems of Petroleum Finance

Financial problems arising from the expansion of the oil industry to meet world energy demands were discussed recently in a speech by C. M. Vignoles, managing director of Shell-Mex and BP Ltd. The occasion was the launching of the new 18,000-dwt Shell tanker *Hinea* by Lady Kenning at the Barrow shipyard of Vickers-Armstrongs Ltd.

After thanking Lady Kenning for acting as sponsor to the vessel and referring to the work of Vickers-Armstrongs at Barrow, Mr Vignoles turned to the financial problems of the oil industry.

The oil industry, he pointed out, had to finance the greater part of its capital investment out of its own earnings. Yet oil products continued to be main victims of taxation all over the world. "It is to be hoped that the governments of the world are at least aware of the repercussions which may one day follow", warned Mr Vignoles.

World energy requirements would double themselves by 1980 and until atomic power became a significant factor the oil industry would be called upon to make an increasing contribution, particularly in the form of fuel oil. It was expected that in 25 years' time consumption of petroleum products would be nearly two-and-a-half times the present figure. The oil industry would have to provide, not 700 million tons of oil as at present, but 1500 million tons each year.

"There is no fear that oil resources themselves will not be adequate to meet even these huge demands", said Mr Vignoles. "It is the financing of these developments which is likely to be the more serious problem.

"Already, since the war, upwards of £12,000 million have been spent to maintain and expand the industry's operations. Now it is faced with an enormous capital expenditure programme which may be of the order of £2000 million a year for the next twenty years".

Speaking of the high cost of exploration, production, refining, transportation, storage, and distribution, and in addition the cost of new pipelines and the world tanker fleet, Mr Vignoles asked where the astronomical sum needed for maintenance and expansion was to be found. There was little hope of borrowing more than a small proportion of it from the money markets of the world. By far the greater part of the funds necessary to carry on the oil industry from year to year must continue to come out of net earnings.

"There seems no other way", said Mr Vignoles, "in which this essential capital requirement can be fully met. 'Essential' because without it the world will go short of the energy it needs.

"In spite of this oil products continue to be the main victims of taxation all over the world. In 1954 Royal Dutch Shell paid to governments in sales taxes, excise duties, and other levies no less than £406 million. Over the four years from 1951 to 1954 an increase in net income of only £13 million was to be compared with a rise in this type of taxation of £144 million.

"In a world where industry and commerce generally have come to bear the greatest responsibility for the future of human affairs, it is folly to imagine that the problem of one industry is not a problem for all".

Around the Branches

BAHRAIN, FAWLEY, KUWAIT, LONDON, NORTHERN, SCOTTISH, SOUTH-EASTERN, SOUTH WALES, STANLOW, TRINIDAD

Fawley Branch

The 1955–56 session of the Branch opened on 9 September with a supper dance. This function has now become an established practice, and members showed their appreciation by turning up in strength, together with their wives and friends.

S. A. Berridge, the Branch Hon. Secretary and Treasurer, acted as M.C. for the occasion and after welcoming the guests he proceeded to keep the party at a "cracking" pace.

Dances were interspersed with party games and competitions, which gave as much amusement to onlookers as to those taking part. In an item called "Musical Hats" some "very latest models" were paraded and gradually reduced in number, with a fight for the last remaining hat between P. G. Pinder and Mrs F. M. Preston. As might be expected in such a competition, the lady won. Don Clark won a competition in eating a "Mars Bar" with the help of a knife and fork whilst fully dressed in a suit of protective clothing, complete with gloves. An indoor "hockey match", in which walking sticks and a bag of beans were substituted for more recognized implements, was another item which quickly got more and more exciting. Goals were scored rapidly, and the winning members were presented with trophies (nutty bars).

During the course of the evening a draw took place for a basket of fruit which was presented by Mrs F. Mayo, wife of the Esso Refinery Manager, to the winner, C. Bristow.

Before parting, Mr Berridge thanked all those who had taken part in this function for their kindly support, and made generous reference to all those who had helped with the arrangements.

South-Eastern Branch

The first meeting of the new session, held at the King's Head Hotel, Rochester on 6 September, took the form of a filmshow. Four films were shown—*The House that Jack Built*, a cartoon film dealing with the scrap metal drive, and an instructive trio tracing oil through drilling, transportation, and refining to the final products—*The Birth of an Oilfield*, *We've Come a Long Way*, and *Refining of Oil*. Forty members and friends were present.

During the evening, N. W. Grey announced his resignation from the position of Branch Chairman which he has filled so ably since the inception of the Branch.

Northern Branch

The first meeting of the 1955/56 session, at which the new Branch Chairman, G. M. Davies, presided, was held on Tuesday, 20 September.

H. E. F. Pracy delivered a paper entitled "The Place of the Chemical Engineer in the Petroleum Refinery Industry". He recalled his early days in the petroleum industry when chemical engineering was almost unknown and the chemical engineer a rarity, and he traced the gradual growth of chemical engineering to its present-day level.

Discussing the relative importance of mechanical engineering, chemistry, and chemical engineering, Mr Pracy emphasized the complementary nature of these sciences and reminded the younger element in his audience that personal effort and ability were far more important than a mere label. The newly-qualified chemical engineer should spend some time in learning to carry out successfully all the minor jobs connected with plant operation, graduating to shift supervisor, assistant plant manager, and eventually plant manager. Such a training, followed preferably by a period as maintenance engineer, would ensure that processes eventually designed by such a man would have the twin virtues of "operability" and "maintainability". Mr Pracy, however, refused to accept that chemical engineering design was the only eventual niche for the chemical engineer; he could think of no better qualification for process managers, and listed avenues such as technical service and sales, and economic study groups, as well as research. Whilst Mr Pracy would not disqualify chemical engineers from management, he was concerned to show that management, being largely an administrative function, could frequently be carried out equally well by accountants and economists, and that the choice was of the person rather than of the qualifications.

Mr Pracy concluded by saying that he had intended his paper to be provocative. The provocation he had offered resulted in a vigorous discussion and a demand for details of courses from the unqualified men present who had been attracted to this lecture by the nature of the paper.

The meeting closed with a vote of thanks to the speaker.

Trinidad Branch

The 148th general meeting of the Trinidad Branch was held at the Apex Club on 5 August, 1955, with the Branch Chairman, J. A. Hulme, presiding. Dr A. L. Down presented a paper prepared by R. A. L. Davies and himself entitled "Taking a Look at Petrochemicals". The authors introduced the subject by enumerating the major source of materials, or building blocks as they have been called, in the petrochemical industry and illustrated how these starting materials came into the possession of the refiner, by a series of colour slides showing the processes involved in a modern fully-integrated refinery. The older "by-product" chemicals from the petroleum industry, such as petroleum coke, sulphur, and naphthenic acids were also dealt with as well as the great variety of products that could be obtained from synthesis gas and the methods of obtaining this important material from natural gas. The production of ammonia and urea were singled out for a more detailed presentation.

A series of slides was used to show the amazing growth of the petrochemical industry, particularly in the field of detergents, synthetic rubbers, plastics, and fibres, whilst other slides were used to illustrate the process steps involved. On the subject of nylon the authors made an interesting speculation on the possibilities of its entire derivation from furfural obtained from sugar cane fibre.

The Branch Chairman proposed a vote of thanks to the authors.

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Council Elections 1956

Members are reminded that, under By-law 72, all nominations for the Council Elections in 1956 must be received by the General Secretary not later than 31 December 1955.

Applications must be made on the special Council Election form, proposed by a corporate member, and supported by six corporate members. These forms can be obtained from the General Secretary, 26 Portland Place, London, W.1.

CBMPE Dinner

G. V. Sims, chairman of the Council of British Manufacturers of Petroleum Equipment, speaking at the Annual Dinner of the Council on 29 September, said that there were over 400 members of the Council, a massive pattern of the British engineering and allied industries collectively engaged in supplying the widest range of equipment needed by the petroleum industry.

During the first six months of 1955 the petroleum industry had placed orders worth £63 million in Britain, in the main with members of the Council.

Briefly, the Council's policy was to form a bridge between the petroleum industry and its many suppliers. It was proposing to hold talks at appropriate levels to ascertain from the petroleum industry its current problems regarding supply and to try to meet them. An informal discussion was also being planned to tell the petroleum industry what research and development were going on in the various aspects of metallurgy, especially where these had been carried out for other industries. The Council was also doing everything possible to provide information to members going abroad.

Lieut.-General Sir John Eldridge, K.B.E., C.B., D.S.O., M.C. (Controller of Munitions, Ministry of Supply), replying on behalf of the guests, said that the Ministry of Supply was bound to be interested in the Council for three reasons.

First, this might almost be described as the oil age. Nuclear power was hardly yet with us. Oil was perhaps the most concentrated, easily handled, and transportable source of power. The Services were most interested in it and used it in quantity. Oil fired, diesel- and now jet-turbine-propelled ships—piston and now jet-engined aircraft—army vehicles, fighting and load-carrying, all depended on oil.

Secondly, the activities of many of the members ranged much more widely than the manufacture of oil equipment. Steel makers, light metal firms, manufacturers of plastics, makers of nuts and bolts and of the many much more complicated bits and pieces which go to the making of modern armaments were obviously of interest to the Ministry.

Thirdly, and perhaps most important, sound defence could only be based on a sound industrial economy. As our industrial economy flourished, so should we have a sound defence potential. The Council represented a substantial part of the country's industrial resources.

The Ministry had its own research and development establishments but while they were powerful and valuable instruments, they were bound to specialize to a great extent on work which was not done elsewhere.

There was so much going on in materials, in design techniques, and in production methods that they must have outside help. This they got through the universities, the great professional institutions, and industry.

As a non-technical soldier he was not competent to say how far what he saw represented real progress, but almost everywhere he was shown new methods of production or the extension of older methods to larger articles or new machinery.

General Eldridge went on to stress the importance which attached to the work of the Council as a whole and of all its industrial members. He hoped that they might go from strength to strength, and concluded by wishing them prosperity in the future, and proposing their health.

The toast was responded to by L. S. Dawson, a member of the Executive Committee.

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U.K. PETROLEUM CONSUMPTION

There was an increase of over a million tons in U.K. oil consumption (excluding bunkers) during the period January to June 1955 compared with the same period in 1954.

Figures published by the Petroleum Information Bureau on behalf of the U.K. Petroleum Industry Advisory Committee show that sales of premier grade spirit continued to increase while sales of standard grades continued to decline.

Detailed figures are as follows:

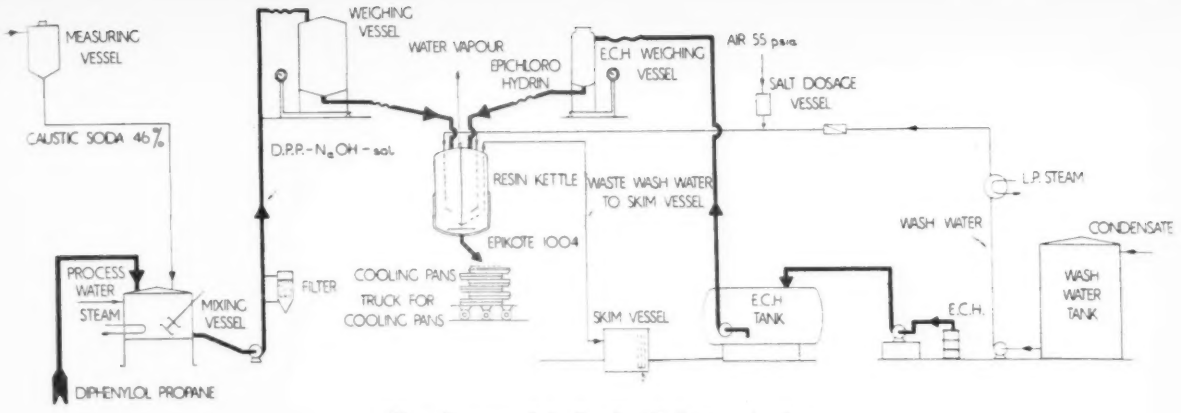
U.K. Deliveries into Inland Consumption of Petroleum Products (in tons) January to June

Product	1954	1955
Motor spirit (incl. motor benzole)	2,811,317	2,973,342
Industrial spirits (incl. industrial benzole)	59,621	66,006
White spirit	73,743	74,836
Kerosine:		
Burning oil	335,503	388,160
Vaporizing oil	397,627	373,833
Total kerosine	715,130	761,993
Derv fuel	671,302	767,506
Gas, diesel, and fuel oils:		
Gas-diesel oil	984,509	1,167,248
Fuel oil	2,228,054	2,768,224
Total gas, diesel, and fuel oils (excl. refinery consumption)	3,212,563	3,935,472
Refinery consumption	932,019	1,035,773
Total gas, diesel, and fuel oils (incl. refinery consumption)	4,144,582	4,971,245
Lubricating oils and greases	420,397	438,483
Paraffin wax and scale	23,095	23,541
Propane and butane	27,872	30,164
Bitumen	401,827	409,186
Other products	945,363	1,110,360
Total all products	10,294,249	11,626,662

Note: Deliveries for bunkers for ships engaged in the foreign trade are not included. Figures refer to *inland consumption* only.

U.K. Motor Spirit Deliveries to Dealers and Commercial Consumers (in tons) January to June

Category and Grade	1954	1955
Dealers:		
Premier grades	1,162,013	1,298,381
Standard grades	693,866	690,847
Total	1,855,879	1,989,228
Commercial consumers:		
Premier grades	143,874	156,766
Standard grades	811,564	827,348
Total	955,438	984,114
Total:		
Premier grades	1,305,887	1,455,147
Standard grades	1,505,430	1,518,195
Total	2,811,317	2,973,342



Flow diagram of the Stanlow Epikote resin plant.

"Epikote" Resin Manufacture in the U.K.

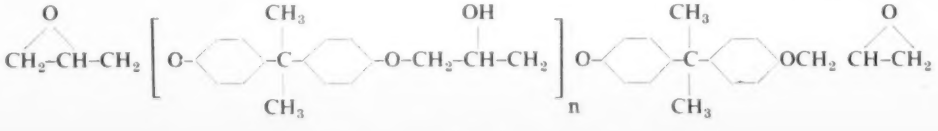
"Epikote" resin, a condensation product of epichlorohydrin (ECH) and diphenylolpropane (DPP) developed by "Shell", is now in full-scale manufacture at the Stanlow refinery and recently members of the technical press were privileged to visit and inspect the plant.

The use of these resins in the field of chemical-resistant surface coatings is now well-known and covers domestic equipment and industrial machinery, drums, cans and similar containers, automobile and aircraft finishes, wood and floor finishes, laminating, PVC stabilizers, etc. They are manufactured in different grades to suit specific applications and are clear and amber in colour, varying from a viscous liquid of 9°–12°C melting point to a hard solid with a melting point of 145°–155°C.

A Shell photo

Operators "skimming" wash water from the reactor kettles.

As mentioned above, these resins are made by reacting epichlorohydrin with diphenylolpropane in the presence of a caustic soda solution, their general chemical structure being:



The principal basic materials are produced mainly from petroleum refinery products. The DPP is prepared at Stanlow in an adjoining plant from phenol and acetone, the latter being derived from refinery gases. The ECH is also obtained from refinery gases, but at present is imported from the U.S.A.

The Process

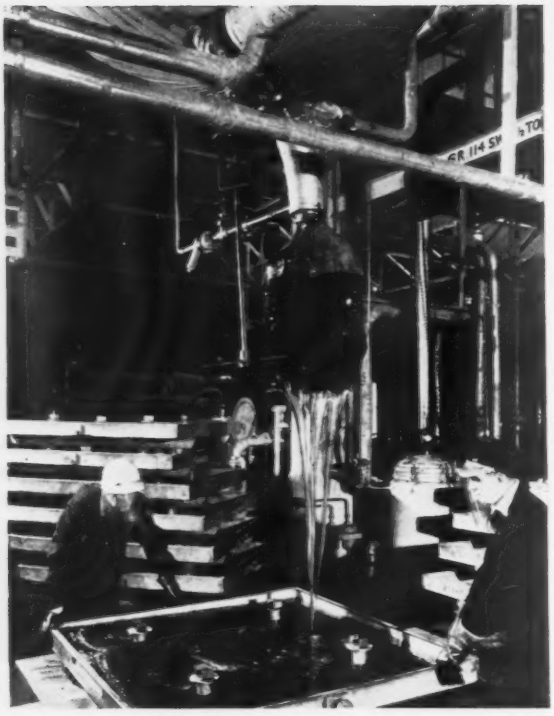
The plant at Stanlow is operated by the Shell Chemical Co. Ltd. and is designed to produce seven grades of resins varying according to the proportion of DPP to ECH used in the reaction. The higher the proportion of DPP the longer the chain and the harder the solid resin. Short chain resins have a lower proportion of DPP to ECH and are syrupy liquids.

The Epikote and DPP plants at Stanlow were both designed in Holland and erected by a British engineering firm. They cost together about £700,000 and have a design capacity of approximately 2000 tons of resin per year.

The heart of the Epikote plant, a flow diagram of which is shown above, is the two large reactors of welded stainless steel construction. Each reactor is fitted with anchor-type stirrers having stainless steel blades on shafts of mild steel clad with stainless steel. The stirrers are driven by 83-h.p. motors through variable speed hydraulic drives. One reactor which will normally be used for making liquid resins is equipped with a reflux head to remove water from the system and to return to the reactor the excess ECH used for these grades. Either reactor can be used for solid grades and two similar reactors can be added when demand warrants this.

All reactants are carefully filtered before passing to the reactor.

The reaction of DPP and ECH takes place with the evolution of heat, and after a period of stirring the material is allowed to settle into two layers. The upper water layer contains salt and is skimmed off and the "taffy" or reaction product is washed with very pure water to remove organic chlorides. The wash water is introduced below the "taffy" level and is drawn off up a pipe which is just below the surface of the liquid. A slight positive pressure applied to the vessel causes the wash water to rise through the "dip" pipe.



The Epikote resin unit. Photo shows resin running out on to the stainless steel cooling trays.

A Shell photo

When the reaction is completed, the dry molten resin is run out into stainless steel trays where it solidifies. It is then broken up into fairly large pieces and passed through a crushing machine to ensure a consistent particle size. The crushed resin is blended in a vertical conical mixer and weighed into paper-lined sacks.

Throughout, the plant is furnished with temperature and flow controllers and wash-water acidity is automatically determined and an alarm given if a certain value is exceeded.

Performance Testing

Each batch of Epikote is tested in the plant laboratory as a check on quality. For this purpose a lacquer or enamel prepared from the resin is sprayed to a prescribed thickness onto a prepared panel and the following tests applied:—impact, mandrel bend, solvent resistance, water resistance, and alkali resistance. Other tests include esterification, drying time, re-coating, and a cold test and a solvent extraction test for the liquid grades.

Epikote in Use

After leaving the Epikote plant, a visit was made to the "Teepol" plant where for a long time corrosion was a problem owing to the presence of olefins, sulphuric acid, moisture, etc. In October 1954 this plant was completely stripped and re-coated with Epikote-based finishes. No sign of corrosion has since been noticed and it was stated that no troubles had been encountered.

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Council Commentary

Council met on 14 September under the chairmanship of G. H. Thornley who deputized for the President and discussion over a wide range of subjects was both vigorous and interesting. The following covers the "highlights" of the discussions and decisions arrived at.

The activities of Public Relations Committee were studied with much interest, especially the possibility of arranging lectures for children on the various phases of the petroleum industry. It was felt that this matter was a very worthy one and should be proceeded with immediately.

The Engineering Committee presented three reports which showed that their monumental task of producing the various Codes, such as the Electrical, Marketing, and Refining Safety Codes, is nearing completion. These Codes, it is anticipated, will be of great benefit to those responsible for refinery operation.

Dr E. B. Evans described the recent activities of the Publications Committee and announced that the programme for the 1955–56 session had been completed and that the organization of the technical programme for the 1956 Summer Meeting was well in hand. Members should note that a notice announcing the Summer Meeting would shortly be issued and this would give details of the technical programme, which should interest a very large number of petroleum people. Council gave its approval to Publication Committee's proposal to issue a library catalogue as it was generally felt that, as the IP Library contains so many books not readily available to most technical organizations, this would be of very considerable value to members whose work lies outside the London area.

It was decided, on the advice of the Awards Committee, to give an annual prize to the value of £10 to the student member producing the best technical paper of the year. Publications Committee will be responsible for advertising the prize and for judging the contributions.

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SS. World Glory *pictured at Thames Haven where she discharged the largest cargo of oil ever to be handled in the Thames—*40,500 *tons of Kuwait crude oil delivered in* 30 *hours for processing at the Shell Haven refinery.*

The pièce de résistance *of the display was the performance of 54 Squadron, led by Captain Immig of the U.S. Air Force. The precision flying of these four* Hawker Hunters *left the spectators breathless.*

The 1955 Farnborough Air Show

From the tiny Folland *Gnat* (span 22 ft 2 in; length 29 ft; height 8 ft 9 in) to the giant Blackburn *Beverley* (span 162 ft; length 99 ft 2 in; height 38 ft 5 in) each machine, engine, or component exhibited at the 1955 Farnborough Show of the Society of British Aircraft Constructors was a tribute to Britain's supremacy in the field of aircraft design and construction.

This, the sixteenth of such events, was as usual a combination of a flying display of Britain's latest machines, a static exhibition of aircraft, and an indoor exhibition of equipment and components.

The flying exhibition was almost breath-taking as the pilots, many of whose names are household words in aviation, showed what their machines could do.

Among the machines which took part in the flying demonstration were the Folland *Gnat* 1, the *Canberra* (one version of which recently established a world altitude record of 65,876 ft, while another version completed the journey London–New York and back in under 15 hours), the *Comet* 3, the *Herald*, the 2-seater *Hunter*, the *Britannia*, the turboprop *Elizabethan*, and the *Viscount*. The antics of the various types of helicopter were indicative of the versatility of this type of craft and both the *Jet-Gyrodyne* and the new Fairey ultra-light machine were seen in flight. A particularly spectacular display was that of the four *Hunters* of No 54 Squadron of the R.A.F.

The Exhibition

Among the aircraft and equipment demonstrated and displayed, the products of several IP Member-Companies were noted and are outlined below.

The English Electric Co. Ltd.—Apart from the *Canberra* aircraft mentioned above, the Company's indoor exhibition included models of the new P.1. fighter, the first single combat aircraft to achieve supersonic speed in level flight, and the *Canberra* Mark 9 high altitude photographic reconnaissance aircraft. The exhibits also illustrated the Company's guided weapons systems, and complete electrical systems for aircraft.

Thomas Boorn & Co. Ltd.—Fuel hose assemblies, couplings, and special fittings.

The British Petroleum Co. Ltd.—Petroleum products for aviation purposes.

Esso Petroleum Co. Ltd.—The fuel, oil, and hydraulic systems of the *Viscount* were featured to illustrate the use of the Company's products in this craft.

Imperial Chemical Industries Ltd.—The Metals Division exhibit was concerned with titanium and aluminium and their alloys for use in aircraft construction, while the Paints Division showed various aircraft finishes. Plastics for the aircraft industry were shown by the Plastics Division.

Manchester Oil Refinery (Sales) Ltd.—The Company exhibited various specialist oils such as hydraulic, engine, transmission, and gear oils, together with greases and anti-freeze. Flaw detection inks for the non-destructive testing of components were also displayed.

The Mond Nickel Co. Ltd.—Publications and information concerning nickel alloys, magnets, light alloys, spheroidal graphite cast iron, and palladium brazing.

The Pyrene Co. Ltd.—Fire detection and protection equipment and systems for aircraft and airfields were displayed indoors, and in the open one of the Company's crash and fire tenders was on show.

Rubery Owen & Co. Ltd.—Aircraft standard parts, bolts and nuts, machined assemblies, sheet metal work.

[*Continued overleaf*

British aircraft in flight. (Left) *The* Britannia *Mark* 100; (centre) *the Handley Page* Herald, *a* 36–44-*seat medium range transport which first flew in August;* (right) *the Bristol Type* 173 *helicopter with two Alvis* Leonides *piston engines.*

Photos by R. G. Sell and G. Sell

Trade Literature, etc.

Zinc Dibutyl Dithiocarbamate

An information bulletin containing data on the use of zinc dibutyl dithiocarbamate, an oil additive, is available from Robinson Brothers Ltd., of Ryders Green, West Bromwich.

Seismic Instruments Ltd.

A new company, Seismic Instruments Ltd., has been formed to develop, manufacture and market portable equipment for use by geophysical prospecting teams. Joint proprietors of the new company are Electro-Technical Labs. Inc. of Houston, Texas, and Pye Ltd. of Cambridge. Manufacturing facilities will be provided by W. G. Pye and Co. Ltd.

Changes of Name

The name of The India Rubber, Gutta Percha, and Telegraph Works Co. Ltd. has been changed to Silvertown Rubber Co. Ltd.

Trinidad Leaseholds (Canada) Limited announced recently that the name of the Company has been changed to Regent Refining (Canada) Limited.

Iranian Production and Refining Figures

During August 1,451,000 tons of oil were produced by Iraanse Aardolie Exploratie en Productie Maatschappij, N.V., contributing to a total production of 9,771,000 tons for the period 1 January to 31 August.

The refinery throughout at Abadan during August was 634,000 tons, giving a total of 4,981,000 tons refined by Iraanse Aardolie Raffinage Maatschappij N.V. up till the end of August.

Automatic Fire Protection for Tanks

A new method of extinguishing fires in large oil and petrol storage tanks has been evolved by The National Fire Protection Co. Ltd. It is based on the use of vaporizing liquids to extinguish fire automatically and immediately in its early stages by blanketing the zone between the inflammable liquid surface and the flame.

The equipment used consists of a floating vessel containing vaporizing liquid, either methyl bromide or chlorobromomethane, which can be fitted to any type of tank. In a central position on the floating vessel are a contra-rotating head and an automatic detector head. The whole unit is free to rise and fall with the level of the inflammable liquid in the storage tank.

Detector arms connected to the central detector head give coverage over the whole tank and on the outbreak of flame or a rise in temperature (to a predetermined figure) vaporizing liquid is released under pressure through contra-rotating jets over the surface of the inflammable liquid.

Full details of this equipment are obtainable from The National Fire Protection Co. Ltd., Essex Works, Feltham, Middlesex.

Pitan Bitumen Sealer

A new product is now being marketed by Allweather Paints Ltd. for application to surfaces which have been treated with bitumen. Known as Pitan Bitumen Sealer, it is supplied in white and can be overpainted with any decorative finish.

CRUDE OIL PRODUCTION

	July	*Jan.–July*
	Tons	
Qatar Petroleum Co. Ltd. . .	459,595	3,053,915
	Aug.	*Jan.–Aug.*
	Brl.	
Trinidad Petroleum Development Co. Ltd.	305,056	
Kern Oil Co. Ltd.:		
California	102,500	
Trinidad	82,501	
	Tons	
Qatar Petroleum Co. Ltd. . .	458,552	3,512,467
Iraq Petroleum Co. Ltd. . .	2,179,528	15,938,696
Basrah Petroleum Co. Ltd. . .	617,567	4,580,867
Mosul Petroleum Co. Ltd. . .	111,539	853,417
Kuwait Oil Co. Ltd. . . .	4,370,564	36,318,786

[*Continued from previous page.*

Shell-Mex and B.P. Ltd.—The products distributed by the Company were shown and information regarding the aviation services of Shell and BP was available.

Among the many other exhibits, the following were noted:—

Elliott Brothers (London) Ltd.—Flight instruments and control systems, flowmeters, radar and electronic equipment.

Fibreglass Ltd.—Heat, sound, and electrical insulation, and reinforced plastics for the aircraft industry.

Pye Ltd.—Navigational equipment, instrument landing systems, radio equipment, scientific instruments.

Henry Wiggin & Co. Ltd.—Corrosion- and heat-resisting alloys for aircraft gas turbines.

(Left) *The Bristol* Britannia *Mark* 100 42-*seater passenger airliner, equipped with four* 3780 *e.h.p.* Proteus 705 *turboprop engines;* (centre) *the English Electric* Canberra, *powered by two Bristol* Olympus *engines, which in August established a new height record;* (right) *the* Eland Elizabethan, *equipped with two Napier* Eland E1.1 *turboprop engines, which is a test-bed version of the* 47-*seater machine operated by BEA.*

Investment in the Oil Industry*

By F. C. WADDAMS†

The Size of the Oil Industry

It is a trite though necessary introduction to an analysis of investment in the oil industry to mention that its growth has been unique in modern times, and that from the humble task of lighting the lamps of China, it has come to be the basis, the foundation, the *sine qua non* of the modern industrial economy; that it has done all this in half a century; and that, while other industries have grown faster, they have not reached such a size; and none has the flavour of romance which, according to the story books, surrounds the oil industry. The popular press seldom refers to the industry or that part of it in this country without the liberal use of words such as "giant" "millions" "leviathan" "gargantuan". "To strike oil" signifies the achievement of some outstanding piece of good fortune; and indeed this phrase, derived from the oil industry which has enriched the English language, carries in its connotation all the latent excitement which in the popular imagination clothes oil and the search for oil.

There is justification for some of these impressions some of the time, but not all of them all of the time. What are the facts? Of the 30 largest industrial companies or organizations in the world, one-third are oil companies. Oil is the largest single item in international trade today. It is now the greatest single source of energy in the world, and it is undoubtedly destined to become increasingly important. It spells the difference between opulence and poverty for a country in its balances of trade and payments with the rest of the world. It has provided for many years, for instance, over 95 per cent of the foreign exchange earnings in a great producing country like Venezuela, whose main sources of income from abroad before the advent of oil had been cocoa and coffee; while other countries, less gifted with this natural source by nature, or where the art of man has not yet succeeded in wresting it from the ground, must devote large portions of their foreign exchange earnings to its purchase. One country is at present devoting nearly half of the proceeds of her exports to buying imports of oil, while proportions of around 10 per cent are not uncommon among importing countries.

The period of greatest development has been the last decade, since the second world war. The rate of increase in consumption in the world outside the U.S.A.—and it is this part of the industry which is primarily to be considered here—has been of the order of 10 per cent p.a., and as the figures grow larger, the absolute increases in consumption become year by year almost alarmingly greater. Although such a high rate as 10 per cent cannot be expected to be maintained, the increase over the next few years is still expected to be high—probably in the region of 7 per cent.

Thus the investment grows at an accelerating pace, and as it grows it requires larger and larger funds to back it. The figures involved are so large that it is worth enquiring into the conditions in which these great sums of money are forthcoming, in a world clamouring for capital for every kind of investment.

It cannot be too strongly stressed at the outset that the funds invested in the oil industry are provided with the ultimate object that they should obtain a reasonable return. All reasonable shades of political opinion would, in fact, agree that a return on investment is normally a criterion by which an activity's usefulness to the community, or the communities of the world, may be judged. It shows that consumers are able and ready to pay for the article what it has cost to produce, and therefore its value to them is greater than the value of the effort and materials put into its production.

The Unit of Investment

The international oil industry is unsuited to the operation of small financial units. There are few, if any, authentic "get-rich-quick" stories in the industry nowadays. For even if the funds are available, no private or institutional investor is, on his own, going to put his money into a long-shot speculation in the search for oil in an untried place in a strange and far-away land without strong hopes of rich reward. Plenty of people are prepared to invest in success, to hitch their waggon to a star. They will, of course, invest in a going oil concern, but they would not even do this if their investment were tied to an exploration in an unproved area which, if unsuccessful, would be lost. Surprisingly many exploration ventures are unsuccessful, and these are forgotten. The great successes, which in the world outside the U.S.A. can be counted almost on the fingers of one hand, stick in the memory.

Besides the hazards involved there are today enormous expenses which must be incurred by the prospector for oil before he ever begins to look for it. The negotiations leading to the taking up of an exploration concession are normally laborious and costly. An intending prospector requires reasonable assurances that, if by a remote chance oil is found, the enterprise will be appropriately rewarded.

There are other matters, such as negotiating a reasonable basis for the division of any earnings between earner and fiscal authority; and obtaining assurances that, in the event of success, sufficient foreign exchange will be forthcoming, and not all earnings will be forcibly retained in the country. This is necessary so that the architect of success may recoup at least part of his original investment in the coin of his homeland, from which the investment was made.

To these factors must be added the costly scientific organization and activity required for assessing potentialities from a geological standpoint. All these preliminaries take time, money, brains, and experience, and they are what a new man would have to perform before he even started the serious job of prospecting for oil. He must pay a large entrance fee to the paddock before staking his money on a long shot—before he starts his first "wildcat" which is itself defined in the dictionary as a "rash project" or "risky enterprise".

These considerations have a highly practical significance not only in exploration but also in the field of refining, when consideration is given to the establishment of refineries in areas of consumption. In all phases of the integrated oil business the unit of investment is large. In a single exploration venture it is now improbable that the cost will be less than £10 million; exploitation of success may require many times this figure; a modern full-scale refinery may cost as much as £40

*Paper read to IP Economics and Operations Group on 4 October, 1955.

†The Shell Petroleum Co. Ltd.

or £50 million. An 18,000-ton tanker at present costs well over £1 million and a 32,000-tonner more than £2 million. A marketing organization on anything but a local and temporary scale requires not only large sums of money, but the intangible element of goodwill, the most important of its assets, which is built up only over many years of service. The return on investment in any one of these phases or any place is doubtful, unless on the one hand supplies of crude oil and on the other a market for the products are assured; and this assurance is best obtained by the investment being part of an integrated business.

The Cost of Supplying New Oil

A reasonable estimate of the capital cost involved in providing refining, transporting, storing, and distributing facilities for the annual increases in trade of today's dimensions puts the figure at £20 for each additional ton of products marketed a year; and the cost of finding and producing this oil, though varying widely in different parts of the world, at the present time may amount to a similar figure. Thus total new investment per ton of increased trade, on an annual basis, may be as much as £40; and the capital expenditure of the whole oil industry at the present time, necessary to supply the present and prospective annual increases in trade, is in excess of £2000 million a year.

Such a sum is more than a quarter of the market value of all ordinary shares now quoted on the London Stock Exchange. It is, to give a different example, of the same order as total gross fixed investment annually in the United Kingdom today—and the United Kingdom is still a major industrial power.

Where are such funds to come from? The hazards and difficulties already described make it impossible for any but a small part to come from new funds subscribed out of the savings of the public, either direct or through institutions such as insurance companies.

It is true that funds will always be forthcoming at a price, in accordance with the elementary principles of supply and demand, and the larger the sums required the greater will have to be the prospective profit and the smaller the risk. It is very doubtful whether the oil industry could offer to prospective investors the conditions which would meet investors' requirements for the whole, or even a moderate proportion, of the large sums required for this size of capital development.

Consequently, nearly all the present-day development of the oil industry is being conducted through the medium of established oil companies, and the greater part of it by means of funds generated within the industry. In this way success is achieved where, if other courses were followed, failure would be almost inevitable. Success is gained because the principles applicable in insurance are observed—the law of large numbers, the spread of risks, and diversity of operations. Although there may be no return, or a negative return, on any one phase or in any one place, the operation as a whole gives prospects of a reasonable return.

The Return on Investment

The average return on capital employed in the oil industry is about 13 per cent, and the return on capital experienced by individual companies clusters round the average remarkably closely—few major companies or groups obtaining above a 15 per cent return or below a 9 per cent return. This refers to invested capital, *i.e.*, the shareholders' equity; on total capital, which includes loan capital, the return is lower and ranges with few exceptions from 7–14 per cent.

It is scarcely necessary to add that these figures do not refer to the return to the shareholders on their investment. From the earnings must be found the greater part of the funds required for new investment, so that what is left for shareholders is only a small portion of the earnings, and their return is only a fraction of the whole return on capital employed.

If there is consistency over a large part of the industry in the return on capital employed at the present time, there is another and less comforting consistency in the movement of this return over a period of time—the past four years. That is to say, the return has been falling, and if the return on the whole investment has been falling, it may be deduced without difficulty that the return on the new investment for new trade has been falling much faster. In fact, to take a representative selection of the 20 largest companies, in the past four years ending with 1954 the return on capital invested has been, in round figures, 15, 14, 13 and 12 per cent. The return on new investment, though more difficult to gauge owing to annual fluctuations both in trade increases and investment expenditures, was clearly much lower in the past three years—perhaps on average lower than 5 per cent—than in the previous two, when it was over 20 per cent.

Another illustration of the increasing significance of the calls made by capital expenditure in the industry is given in the proportion of capital expenditure to the industry's self-generated funds (*i.e.*, to its net income plus write-offs, or "cash income") each year. This proportion has been rising from 70 per cent four years ago to 80 per cent in 1954; and the remaining 20 per cent (leaving aside for the moment the question of borrowing) must supply firstly increased working capital for higher levels of trade, and secondly dividends for shareholders.

To what then can this discomforting tendency be attributed? Firstly, to the factors already enumerated—the cost of finding the oil has risen and is rising—more exploration per unit of oil discovered is continually becoming necessary. The cost of producing oil when found has also been rising. Oil has a knack of being discovered in the most inaccessible and uncongenial spots, and requires echelons of services for its exploitation. For every front-line soldier there are ten supporting troops; and the battle has to be fought with all the refinements and services which accompany an army at war.

Then there are the rises in costs in every phase of the business brought about by the inflation throughout the world—notwithstanding which the prices of oil products in recent times have maintained a remarkable stability. Lastly, the intensification of competition between oil companies has made itself felt in higher quality products, for which particularly expensive items of capital equipment such as cat-crackers are necessary; in improved additives and service advice, behind which are stories of millions spent on research; and in more convenient service station and other supply equipment.

Thus much of the capital expenditure is necessary to maintain, rather than to expand, the business; it is an expense essential for remaining successfully in business, rather than new investment on which greater return can be expected.

Who Benefits?

The beneficiaries of this great expenditure are primarily the oil-consuming public; and they reap the reward of intense competition among the oil companies just as surely, though less obviously, as if there were big price cuts such as have resulted from the battle for the market in the case of certain household products. The added advantage to the consuming public of this type of competition is that the creation of more reserves, up-to-date refineries, fast super-tankers and efficient marketing equipment assure them a high-quality product in plentiful supply at reasonable prices for the years ahead.

The consumer has no grounds for complaint that the price he is paying includes a sum to provide funds for the capital expenditure of an industry in which he has no stake. For in the first place this element is minute in relation to the prices of the products, loaded as they often are with excessive taxes;

the Chairman of "Shell" Transport and Trading Co. Ltd recently stated that profits represented $1\frac{1}{4}d$ a gallon on all oil and products sold by the Shell Group, and it is out of this sum that the funds for new investment are drawn.

Secondly, the retained earnings are used to further the interest and safeguard the stake which every consumer undoubtedly has in the industry—for virtually no consumers of oil products are "fly-by-nights"—the consumer of today will also be using oil tomorrow and next year and in five years' time.

Nevertheless, there might superficially be more substance in representations by shareholders that a greater proportion of profits should be paid out as dividends, and less ploughed back into the industry. Yet a quick glance at the facts shows clearly that it is also in the shareholders' interests that large sums should be ploughed back.

The average proportion of net profit paid out in dividends by the major oil companies of the world in the post-war era has remained remarkably stable, and is well under half of total net earnings. To pay out excessive proportions of earnings at the expense of re-investment would undoubtedly prejudice an individual company's future competitive position. Thus the investment would be impaired and in the long run not only dividends would suffer, but the asset value represented by the investment would also undoubtedly deteriorate.

External Finance

New equity financing of existing companies from external sources is not very common nowadays, and when it does occur often takes the form of "rights" issues to existing shareholders. This implies raising the sums of money required at rather less than the value put on the company's stock by the market at the time of issue—otherwise the new shares would not be taken up.

Such an issue may be beneath the market valuation by a considerable margin, and is then a mixture of the processes of raising money and of making a stock or capitalization issue to shareholders—the latter a common enough practice in the oil industry, which gives recognition to shareholders of the increased and increasing value of their holdings as retained earnings are ploughed back to maintain the business in progress.

Nevertheless, share issues normally suggest the ability to maintain, if not increase, dividend payments *pro rata* on the enlarged capital (unless they are merely stock splits for special reasons), and particularly in view of the lower returns of recent times, it would be unwise, even if it were practical, to carry this process too far. It would result in a watering down of capital, and consequent danger of overcapitalization in lean times.

In fact little new money has been raised in this way for the oil industry in recent years, and exceptionally little in 1954, when only $\frac{1}{40}$th of new money from outside sources was obtained in the form of ordinary stock, and this was largely counterbalanced by repayments of such stock. The remaining $\frac{39}{40}$ths were borrowed. Even so, gross new borrowings amounted to only a quarter of the earnings retained; and—looked at a different way—net new borrowings (borrowings less repayments) amounted to less than 2 per cent of the net self-generated funds (*i.e.*, net earnings plus write-offs less that part paid out in dividends) used in the industry.

This may have been an exceptionally small annual figure, for in fact the long-term borrowings as a proportion of total capital employed fell by a full percentage point in 1954 and are at present about 13 per cent on average. There have been fluctuations in this percentage from year to year, but the figure gives a good indication of the proportion of the capital employed over the whole industry which it has been found appropriate to borrow. Borrowing on a very much larger scale would be impracticable, either because the funds would not be available, or else the credit of the companies involved would not stand it.

Less than half the funds borrowed in this way came from the public, and the remainder from institutions such as banks and insurance companies. The trend towards debt in external financing and away from raising new money by stock issues, and towards borrowing from institutions rather than the public, indicates the growing importance of institutional saving, and the type of investment suited to institutions.

Taxation

Taxation can have a significant impact on investment in the oil industry, and of the various tax expedients which have a bearing on the industry, the percentage depletion systems in operation in the U.S.A., in Canada, and some other countries must first be mentioned. These systems allow a charge against taxable income of depletion based on the value of the output of a well.

Of course, the system thereby allows greater funds to be generated by the companies which benefit from the allowance, and encourages their further search for oil, which the allowance is intended to do and has done with remarkable success in the U.S.A. It also gives the beneficiaries a marked competitive advantage over other oil companies who do not enjoy similar privileges.

There is another important point—and that is the significance such an allowance would have for capital-hungry countries which are marginal producers or possible producers of oil. In such countries oil may be present, but the costs of production are so high as to make operations scarcely worthwhile without some special incentive. Such an incentive may well be supplied by a percentage depletion allowance, thereby bringing about oil exploration and production, with all the attendant advantages, particularly to an under-developed economy.

It is needless to add that such an allowance, if introduced in the United Kingdom taxation system, even if it had little practical import here, would afford an example for the overseas territories whose taxation systems are modelled on the mother country and where the introduction of such an allowance might be of great significance.

Other fiscal measures, although perhaps not in themselves affording funds for the industry to any great extent, may provide important influences in the channelling of investment to one place rather than another. For instance, the Dutch system of exacting no further taxation on income already taxed abroad is likely to appeal to international enterprises, and to encourage the formation in Holland of headquarters of international groups. In brief, while the oil industry cannot claim tax privileges not accorded to other industries—except in respect of its wasting asset, which it has in common with all extractive industries—taxation arrangements are powerful influences in the channelling of investment—stimulating it here, discouraging it there; and this applies not only to production activity but also to manufacturing, shipping, and finally to the establishment of bases from which international industries are directed.

The Future

In summary, and in conclusion, it is the author's opinion that the demand for oil products will remain strong and increase over the next few years and that it can, therefore, be assumed that supplies will be made available to meet that demand. Indeed, the capital expenditure programmes of the oil companies, known and envisaged, make it certain that this demand will be met in the next few years. The decreasing return on investment evident during the past four years, while not a flash in the pan, may be little more than a slight movement downwards from exceptionally high prosperity. It

could not continue to a point at which serious financing difficulties, other than temporary, would be encountered by the major oil companies. The price mechanism, the laws of supply and demand, are bound to produce counteracting influences.

This analysis, therefore, ends as it began, by pointing to the fact that without oil our modern industrial civilization would, for better or for worse, perish. It is therefore incumbent upon that civilization to ensure that the machinery exists whereby these products may be supplied smoothly, plentifully, and cheaply. This has been the case so far, and it is unthinkable that it should not be so also in the future. Provided these conditions are granted, the oil companies may be depended upon to play their role adequately and satisfactorily in the interests and to the advantage of all concerned—the owners, the workers in the industry, and lastly the consumers, who comprise not only the first two classes, but also, directly or indirectly, every citizen of a modern industrial state.

★ ★ ★

Residual Fuel Oils for Gas Turbines

Results of Preliminary Experiments

Experimental work on the use of residual petroleum fuels in gas turbines has been in progress at the Lincoln works of Ruston and Hornsby Ltd. for the last three years. The work has been carried out on Ruston gas turbines in association with the Esso Development Co. Ltd. which has also carried out investigational work on residual fuel burners and an atmospheric combustion chamber.

The results of this work have warranted the decision to conduct further long tests to determine the commercial possibilities of the system and to build up a background of general experience.

The gas turbine used in these experiments was the Ruston 3CT gas turbine fitted with an elbow combustion chamber. (See Figure 1.)

In a preliminary series of tests a number of 10-hour screening runs were carried out to explore the effect of gas temperature over the range from 620° to 770° C and the benefits to be achieved from using various additives which included magnesium compounds, zinc oxide, and ethyl silicate. It was found from these tests that, whilst using magnesium, a considerable reduction would be obtained in the corrosion rate without increasing deposition.

Since these initial tests, a 1000-hour test has been carried out on a fuel containing 3·5 per cent sulphur, together with 50 vanadium, 26 to 62 sodium, and 300 total ash expressed as parts per million. A magnesium additive was used and the test consisted of ten 100-hour runs. The turbine blading was water-washed to remove the small amount of deposit on the blades at the end of each 100-hour run by means of equipment built into the turbine and fed with mains water. No stripping of the turbine was necessary for carrying out the washing process and no other cleaning was required during the 1000-hour test. The time taken for cleaning was about two hours. About 90 per cent of the deposit on the first row of turbine stator blades could be removed in this way and the turbine swallowing capacity was only 3 per cent less at the commencement of the tenth test than at the commencement of the first.

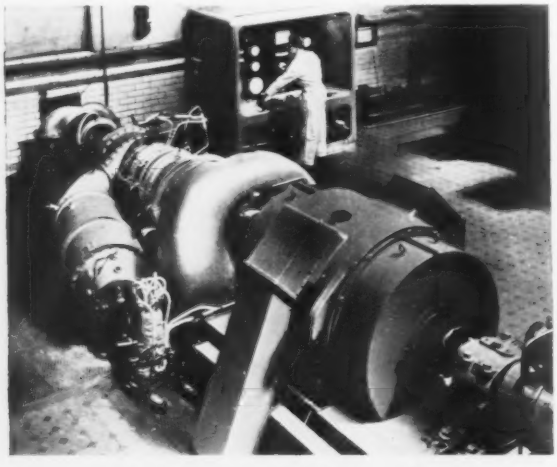


Fig 1. *The Ruston* 3*CT gas turbine.*

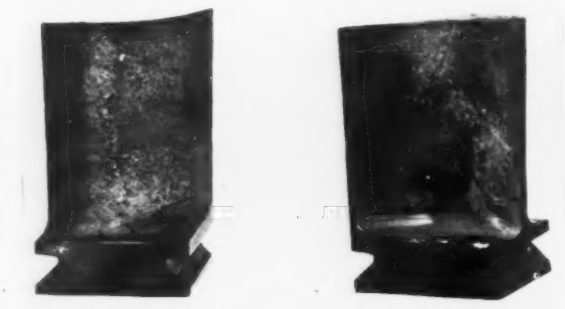


Fig 2. *Convex and concave sides of stator blade after* 500-*hours running.*

The first five 100-hour tests were carried out at a mean gas temperature of 700° C corresponding to rather more than 90 per cent of full load on the gas turbine. Figure 2 shows detailed views of the convex and concave faces of the first row Nimonic 80 stator blades after removal from the turbine on completion of this period of 500-hours running. The photographs were taken by the Mond Nickel Co., who examined the blades and considered them to be in a satisfactory condition for further service and free from serious corrosion.

During the next five 100-hour tests the range of temperatures between 650° and 750° C was investigated as well as changes in the additive concentration.

Books and Films

Oil and Petroleum Year Book

The 46th issue of Walter E. Skinner's well-known standard reference work on the petroleum industry has just made its appearance. It contains complete and reliable information concerning nearly 1000 petroleum companies operating in the petroleum industry throughout the world. In addition, there is a list of managers and engineers totalling over 500, indicating the company with which they are connected.

In dealing with the companies Mr Skinner gives the type of information which has made his book so valuable. Names of directors and other officials are included, with a description of the business, its location, crude oil production where appropriate, and details of capital, dividends, and financial results.

The book is published by Walter E. Skinner, 20 Copthall Avenue, London, E.C.2, the price being 30*s.* net. Postage inland and abroad is an additional 1*s.* 6*d.*

Eagle Fleet

As Sir George Legh-Jones points out in the foreword of this new publication, it is a portrait of the Eagle Fleet, which he describes as a family of men and of ships, covering 43 years from 1912 up to the present time. The Eagle Fleet was founded by Weetman Pearson (later Baron Cowdray) in 1910 and this illustrated account of its activities makes fascinating and interesting reading. It opens with the epic of *San Demetrio* which, it will be remembered, was re-occupied by her crew and brought to port after having been practically burnt out through enemy action during the second war. Then follow accounts of the activities of the fleet in both wars, between wars, and today. The book is written by W. E. Lucas and is excellently produced and illustrated, many of the pictures being in colour. The price of the book, which is published by Weidenfeld & Nicolson, is 9*s.* 6*d.*

Financial Analysis for 1954

In his "Financial Analysis for the Petroleum Industry for 1954" Frederick G. Coqueron (The Chase Manhattan Bank, New York) examines annual reports of 35 U.S.A. oil companies, who between them produce approximately 58 per cent and process 60 per cent of the crude oil supply of the free world. Their net income was $2319 million, an increase of 1.4 per cent over 1953, and the return on total assets averaged 9.3 per cent. To expand and improve facilities, capital expenditure of $3669 million was needed in 1954 and substantial outlays were necessary for exploration and research activities.

Gross assets used in the business amounted to $41,407 million, and working capital increased by $163 million, principally due to funds received from new financing and sale of assets. Combined world-wide operations increased crude oil output by 1.6 per cent and 2.1 per cent more crude was processed than in 1953. Detailed statistical tables are given in the booklet.

Shell Films

In the twenty-one years of its existence, the Shell Film Unit has done much to provide education, instruction, and entertainment through the medium of its productions. The extent to which this has been done is shown by perusal of the contents of the 156-page book which has just been issued to mark the Unit's coming-of-age. This shows that nearly 150 Shell films are at present available in English versions alone, while if all versions in other languages are included the total is 521. The other languages total sixteen and range from Afrikaans to Thai. Incidentally, no training, sales promotion, or local usage films are included in this survey and none of the films carries advertising matter.

Logically, the list opens with the industry itself, and all phases—from exploration to utilization—are covered. Then follow aviation, which includes a series on individual British aircraft, and motoring, which is mainly concerned with the records of the large international racing events.

Under the heading of power and engineering there are three sub-sections—theoretical, aeronautical, industrial. Individual subjects vary from first principles of internal combustion engines to six films on the principles of flight and a similar number on individual examples of the historic Cornish engine.

In the section on agriculture and horticulture, specific plant pests and diseases take ten titles, the other films in this section dealing with various interests from forestry to milk production.

The final section—other subjects—is wide in its scope. It includes fourteen Cinemagazines, each covering several matters of general interest, seven of the series illustrating British crafts and others varying from Indian dancing to the microscope.

Primary circulation of the catalogue is to organizers of film shows for educational and cultural groups, to whom the films are available on loan, free of charge.

The Story of Oil

This new publication, the author of which is Godfrey Harrison, is presumably intended as an elementary introduction to the petroleum industry for children of tender years. Thus, it is very readable and presents mainly that information which may at some time induce the young reader to wish to acquire more knowledge of our industry. Most facets of the industry are dealt with, and some illustrations included. A glossary is appended and although in general only simple meanings of scientific words or petroleum terms have been given, the reader may perhaps be left with the feeling that more words could have been included. For the young reader, however, the book will be of value. It is published by Sir Isaac Pitman & Sons Ltd., the price being 6*s.*

Work Study

Early in 1954 the Council of the Association of British Chemical Manufacturers appointed a work study advisory committee "to stimulate and encourage the application of work study in the chemical industry; to advise on problems arising therefrom; and to report periodically to the Council".

The chairman of this committee was Dr D. E. Wheeler of the Wellcome Foundation Ltd., and one of the results of the work is the publication of a series of reports under the general heading of Notes on Work Study. In the first of these reports, "How to Start", it is shown that initially work study can be quite modest and that expansion can follow as experience is gained. In the introduction to this part, work study is defined as a systematic and detailed study of work with the object of increasing productivity by (*a*) the most effective use of plant and of other material resources, and (*b*) the most effective use of human effort. Thus, it is applicable to any kind of work and the techniques can be used wherever mechanical or physical work is performed. The methods of starting a work study are detailed and various aspects are considered.

The second booklet in the series is entitled "Some Results" and consists of contributions from 14 British firms outlining some of the benefits that have resulted from the application of work study. The firms differ widely in size, and in the goods that they produce, and together the two booklets represent a valuable and practical contribution to the subject. Copies are available to non-members from the Association of British Chemical Manufacturers (Cecil Chambers, Strand, London, W.C.2.) price 5*s.* post free for the two.

Personal Notes

A. M. Robertson has been appointed general manager of Scottish Oils and Shell-Mex Ltd. succeeding T. W. Lyle who retired from the Company on 30 September.

Mr Robertson joined the Anglo-Iranian Oil Company Ltd. (now The British Petroleum Company) in 1937, and after army service was posted to the Marketing Division of the Distribution Department at the Head Office of the Company. In 1949 he was seconded, as the Company's representative, to their French associate's headquarters in Paris. On his return to London Head Office in 1953 he was appointed area manager in the Marketing Division, responsible for marketing arrangements in Germany, Austria, and Switzerland.

In October 1954 Mr Robertson was seconded to Shell-Mex and B.P. Ltd. and in November 1954 was appointed Sales Manager of Southern Division. In July 1955 he was appointed deputy general manager of Scottish Oils and Shell-Mex Ltd.

F. P. Bowden, Sc.D., F.R.S., Reader in Physical Chemistry at the University of Cambridge and a Redwood Medallist of the IP, has been awarded the Elliott Cresson Medal of the Franklin Institute for "his extensive experimental investigations which combine simplicity and clarity, and for his findings regarding the detailed nature of the processes involved when one metal slides over another". The Elliott Cresson Medal is a gold medal awarded for discovery or original research adding to the sum of human knowledge, and for the invention of methods or products, or unusual skill or perfection in workmanship.

Dr F. D. Tuemmler, F.Inst.Pet., of the Shell Development Company's Research Centre at Emeryville, California, has been elected Secretary of the Analytical Section of the International Union of Pure and Applied Chemistry for the period 1955-59. The International Union is a voluntary body whose chief purposes are to establish and promote co-ordination between the chemical societies of the world. It is primarily concerned with those aspects of chemistry about which international agreement and uniform practice are desirable.

Dr Tuemmler, who is an honorary member of the IP Standardization Committee, is known to members through his efforts to promote international co-ordination of petroleum methods.

He first entered the field of international standardization through his own Company's Standardization Committee, of which he is the American Secretary. His European counterpart is Dr H. S. Visser, F.Inst.Pet., BPM, The Hague. The Committee issues the standard Shell Method Series for product testing for use in Shell laboratories throughout the world; the Series draws heavily from the standards used by both the IP and the ASTM.

J. P. Ford has relinquished his post as managing director of the export companies of the Brush Group (Associated British Oil Engines Ltd., Brush Exports Ltd., and National Engines Ltd.) in order to join the Board of Charles Colstan Ltd.

Mr Ford's successor as managing director of the Brush Group export companies is **M. C. Clear,** sales director of the Group. **G. N. Bridge** has been appointed London manager of the three export companies.

A. H. Elliott has been named executive vice president and general manager of Iricon Agency Ltd. which is acting as agent in certain matters relating to the Iranian Oil Consortium for nine independent American oil companies which hold an aggregate interest of 5 per cent in the Consortium.

Mr Elliott has previously spent many years in the service of Standard Vacuum Oil Company.

As general manager of the Agency, Mr Elliott will be in charge of the London office. He will also be a director of Iranian Oil Participants Ltd. and of Iranian Oil Services Ltd.

Dr P. H. Frankel, F. Inst. Pet., who resigned recently from the boards of the Manchester Oil Refinery Group of Companies, intends to devote most of his time to work on the economics of the oil industry. Since publishing *Essentials of Petroleum* (London 1946) he has written regularly on the developments in the petroleum industry. Dr Frankel is now in charge of a newly-formed London company, Petroleum Economics Ltd., which will act as a consultant in its field. W. L. Newton has joined this company.

Photo by Lotte Meitner-Graf

Dr C. G. Williams, member of IP Council and director and general manager of "Shell" Research Ltd, was inducted on 7 October to the Chairmanship of the Automobile Division Council of the Institution of Mechanical Engineers.

Dr Williams has been associated with the Institution for over 25 years and was elected to the A.D. Council in 1950.

The retiring Chairman of the A.D. Council is J. H. Pitchford, managing director of Ricardo & Company Engineers (1927) Ltd.

According to the custom of the Automobile Division, Dr Williams read his Chairman's Address "Some Experiences of Automobile Research" immediately after his election and will follow this up subsequently by reading the Address at the eight centres of the Automobile Division in Birmingham, Bristol, Chester, Coventry, Derby, Edinburgh, Leeds, and Luton.

SHELL-MEX AND B.P. STAFF CHANGES

E. Rendall has become sales manager, jointly with **W. A. Shiach,** Scottish Oils and Shell-Mex Ltd.

A. R. Garrick has been appointed credit manager, London Division.

F. Yeomans has been appointed assistant manager, Jarrow Installation, North Eastern Division.

A. T. Greene has become manager, Portslade Installation, Southern Division.

H. W. Wakefield has become branch manager, Birmingham Branch, Midland Division.

J. M. Gardiner has been appointed manager, Cakemore/Langley Green Installation, Midland Division.

J. L. Austin has been appointed distribution manager, Midland Division.

Trends in Motor Vehicle Populations and their Effect on Consumption of Petroleum Products*

By W. A. C. STRUGNELL†

Of all consumer products for which it is necessary to forecast future demand, few can offer so many problems as the forecasting of consumption of fuel for motor vehicles.

"First catch your rabbit!" might be the opening injunction in the section of a cookery book dealing with the making of rabbit pie. In this case the elusive rabbit is the number and types of motor vehicles in use, but even when this is safely "in the bag", much further preparation is needed before this particular dish is ready for serving. Having obtained an estimate of the numbers of each type of vehicle, it is necessary to decide the average amount of fuel which each is likely to be consuming annually, and to do this one must establish an annual average mileage and mileage per gallon of fuel. All this before any attempt is made to forecast future trends in use and consumption!

The way to the future is essentially through the past, and it is therefore important to consider some of the developments during the past few years in vehicle populations and fuel consumptions.

There are in use in the U.K. today some 5½ million private cars and commercial vehicles, an increase of about 2½ million or 80 per cent over the figure for 1938.

Consumption of motor spirit and automotive diesel fuel during this period, however, after making allowance for the higher mileage obtained with diesel fuel, rose by less than 60 per cent, with fuel consumption per vehicle, expressed in terms of motor spirit, falling from about 580 gallons in 1938 to 510 gallons in 1954. The composition of the vehicle fleet has changed considerably during this period, however, as may be seen from Table I.

TABLE I

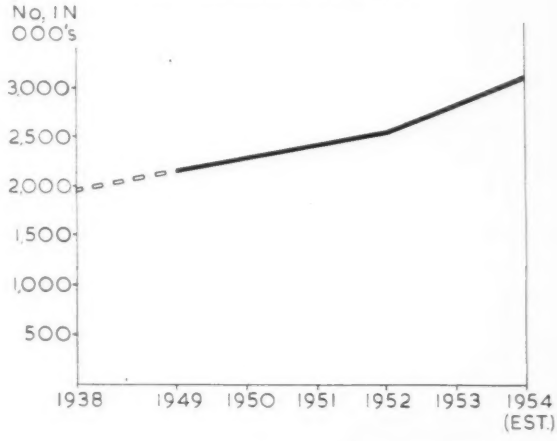
COMPOSITION OF THE U.K. VEHICLE FLEET

	Vehicles per 1000 persons	
	1938	1954
Cars	42	56
Motor cycles	10	21
Commercial vehicles	11	20
Percentage of diesel vehicles	0·8	3·0

Private Motoring

There were about 2 million cars in use in the United Kingdom in 1938. From then until 1949, owing to the war and to petrol rationing, the private car population increased by only about 10 per cent. After this, with more new vehicles becoming available, and economic conditions generally improving, a more rapid increase took place. The 2½ million mark was reached by 1952, after which, with a reduction in purchase tax in the budget of 1953, numbers rose even more rapidly, probably exceeding three million in 1954. (See Chart I). From this picture one's thoughts turn to the future—what is the saturation point, and how soon is it likely to be reached? The current position in the United States is that already one person in four owns a motor car, that three and four cars per family is by no means unusual, that parking problems are becoming so acute that in some areas building regulations make it obligatory for garages capable of holding two cars to be erected with every three-bedroomed house. Even with this situation, the number of cars is still increasing.

Chart I
Private Cars in Use in the U.K.



A car population of 12½ millions or one car for every four persons, may not be likely in these islands, but if we are to expect an improvement in the standard of living of the dimensions forecast by Mr Butler, then this to large numbers of people will mean either acquiring a car or buying a second one if they are owners at present. The post-war years have seen a remarkable increase in the middle income group and a corresponding reduction in the lower income groups. If we take as a yardstick for potential car owners in 1938 those with incomes in excess of £250, we arrive at a total of 2·7 millions. The cost of living increased by about 130 per cent between 1938 and 1953, which means that an income of about £575 would be needed in 1953 to provide the comforts enjoyed on £250 in 1938.

The number of incomes above £575 in 1953 is estimated at 5·8 millions, more than twice the 1938 figure.

The number of cars in 1938 amounted to about 70 per cent of the number of incomes over £250, but the corresponding percentage in 1953, with a lower limit of £575, was only 48 per cent.

While it is not suggested that all these people could afford or have the desire to buy new cars, many of them must be considered likely purchasers for second-hand cars, and a healthy second-hand car market will help to maintain the demand for new cars.

The U.K. motor industry has announced great plans for the future, although an increasing number of new vehicles coming on to the home market must be taken for replacements

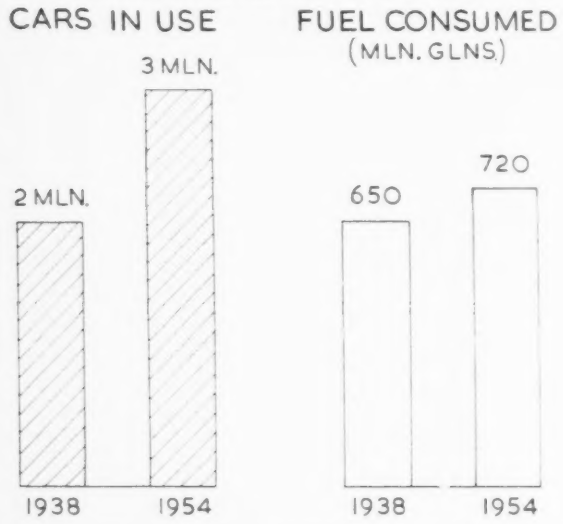
*Paper read to the Institute of Petroleum, Economics and Operations Group, 19 April 1955.

†Esso Petroleum Co. Ltd.

as the scrappage rate inevitably rises from the phenomenally low level of the past few years, the thousands of twenty-plus-year-old cars being discarded in ever-increasing numbers. Having these features in mind, it seems reasonable to suppose that within the next four years we may expect the car population to rise to about four millions. What the peak level may be is virtually impossible to foresee, but it may be controlled to some extent by the pace of the development of the much-needed new road structure of the U.K.

The two million motorists in 1938 averaged about 8–9000 miles a year each, and are estimated to have consumed about 650 million gallons of petrol in the process. (Chart II). In contrast to this the average annual mileage per car in 1954 was probably not more than 6500, giving a total petrol consumption of about 720 million gallons; thus there is only a 10 per cent rise in fuel consumption from a 50 per cent rise in consuming units. It seems apparent that the increase in the number of cars in use today is confined to those used for pleasure only. These motorists are probably covering a maximum of 4500 miles annually, so that as the size of the car population increases, the gap between the rate of the increase and that of the increase in fuel consumption will widen. The main reason for this trend is undoubtedly the high fuel cost, brought about by the burden of taxation; this is a point which has already been discussed at some length by this Group, but it may be pertinent to point out that the cost of fuel for one mile of travel in 1938 was less than $\frac{3}{4}d.$—

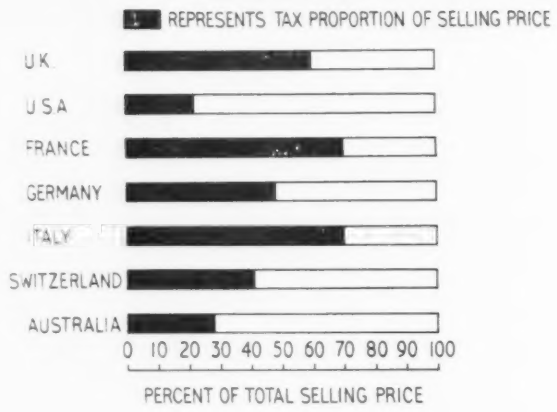
Chart II
Cars in Use and Fuel Consumed in the U.K.



today's cost is 2*d.*—tax representing about 60 per cent of the retail price. (Chart III). Although the taxation in some other European countries is as heavy relatively as in the U.K., in other countries, such as the U.S. and Australia, tax represents only about 20 per cent of the retail price. In the United States, the average industrial worker is able to earn enough money in one hour to buy five gallons of gasoline. His British counterpart would need to work nearly seven hours to produce the same result.

One can hardly leave the subject of private cars without some reference to the possible large-scale introduction of the diesel-engined car. Much has been said and written about this subject, and experience in the operation of diesel taxis seems to indicate that some success has been achieved. The high first cost of this type of vehicle, however, is likely to prohibit its large-scale introduction for private cars for a considerable time to come, and its use apart from heavy

Chart III
Motor Gasoline Taxation
(Commercial Grade)



traction seems likely to be confined to taxis and light commercial vehicles covering high annual mileages. Other possibilities which have been mentioned are gas turbines, petrol-injection and liquefied-petroleum-gas-driven engines, and even the fuel cell. It is likely to be a very long time before these are promoted from the "possibles" to the "probables", at least to any marked extent.

Before leaving the realm of private motoring, attention should be drawn to the increased number of motor-cycles, covering anything from a bicycle with a minute engine perched precariously on top of the rear wheel to the four-cylindered juggernauts which hurtle along the main roads to the peril of all and sundry—including the rider. The number of motor cycles has more than doubled since 1938 and is now around one million. (See Chart IV). About forty per cent of these come into the motor scooter and power-assisted bicycle category, and although these probably consume only about 30–40 gallons a year each, their numbers are increasing steadily.

Public Transport

There have been considerable changes both in numbers and in types of vehicles over the past few years in the field of public passenger transport. (See Chart V).

The number of taxis and hire cars registered as hackney

Chart IV
Motor Cycles in Use in the U.K.

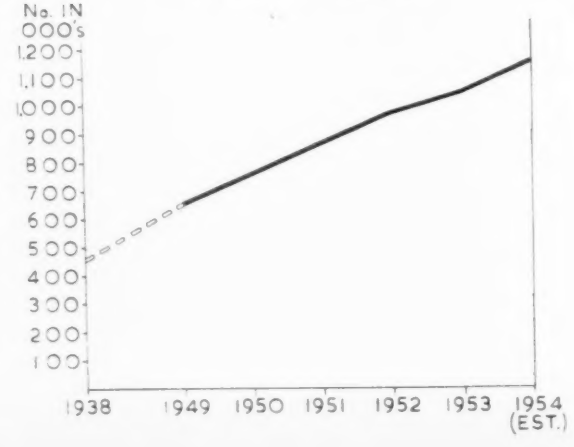
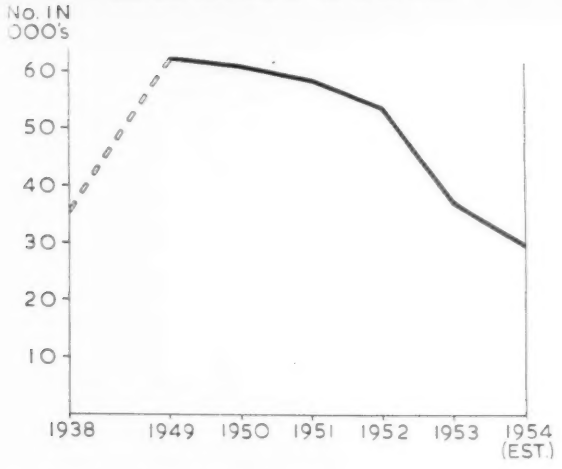


Chart V
Taxi and Hire Cars in Use in the U.K.

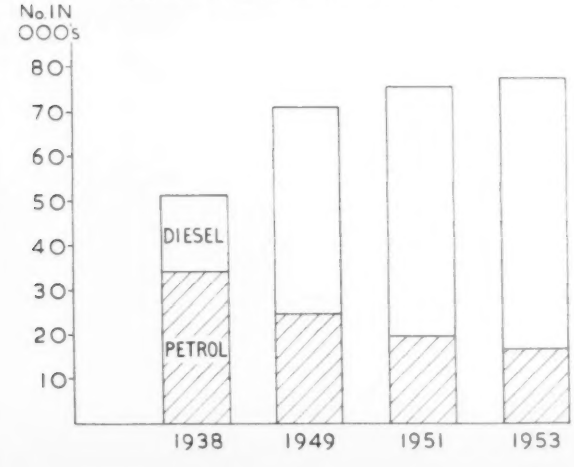


carriages was about 35,000 in 1938, rose to a peak of 61,500 in 1949 owing to fuel rationing and the shortage of new cars, fell away sharply after 1952, and today amounts to only about 30,000. With the continuing growth in the number of private cars, a further decline may be expected, and since these vehicles consume more than 1500 gallons of fuel annually on the average, some of the increased petrol consumption by private cars will be nullified.

A notable development in the taxi fleet has been the trend towards dieselization. This is at the moment mainly confined to the London area, where some of the vehicles cover as many as 60,000 miles in a year. The high annual fuel bill encountered with mileages of this magnitude, bearing in mind that each gallon bears 2*s.* 6*d.* tax, is reduced by £200 to £300 when a diesel engine is installed, owing to the additional mileage per gallon which can be obtained. This saving is ample justification for the expense of conversion of the vehicle.

The number of buses and coaches in use in 1938 was about 50,000, of which 33,000 were petrol and 17,000 were diesel. (See Chart VI). By the September census of 1953 the total had increased by about 50 per cent to 77,000, but within this total the petrol-engined vehicles had fallen to half, and the diesels had risen to more than three times the 1938 level. Apart from a limited replacement of trolley-buses by motor

Chart VI
Buses and Coaches in Use in the U.K.

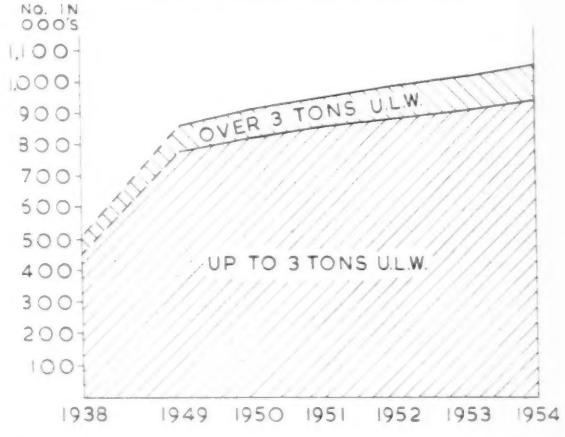


vehicles, the total number is not expected to show any significant growth in the future, but the trend towards diesel engines is likely to continue, although at a slower rate than in the past.

Commercial Vehicles

With commercial vehicles also the growth has been significant, the number in use today being in excess of one million vehicles, more than twice the number in 1938. The greater part of this increase took place in the immediate post-war years, there having been a modest annual growth rate of only about 3–4 per cent during the past five years. (See Chart VII). Increasing rail freight rates, and inadequacies and uncertainties of the railway goods services have led to a greater use of road transport, and a steadily increasing proportion of the country's goods is being moved by this means. The number of lightweight vans for local delivery purposes has shown a marked increase, and National Service and the full employment policy of the post-war era have seen the virtual disappearance of the errand boy and his bicycle. In a paper on the road goods transport industry presented to the Royal Statistical Society a year ago, Messrs Glover and Smith, of the Ministry of Transport, estimated that in 1952 about 900 million tons of goods, representing 19,000 million net ton miles, were carried by road. The comparable

Chart VII
Commercial Vehicles in Use in the U.K.



figures for rail transportation were 300 million tons of goods, or 22,000 million ton miles. This comparison shows that road goods transport plays a major part in the United Kingdom's transport system. As a point of interest, some 60 per cent of the tonnage carried by road is in "C" licensed vehicles, *i.e.* those licensed for the carriage of goods on the licence-holder's own account. The rate of increase in the commercial vehicle fleet now appears to be slowing down, and the recently announced plan by British Railways to re-organize completely its freight schedules, and to carry out a complete modernization programme, may act as a further check and conceivably lead to a swing back to rail transportation. Against this, however, there is the Government's scheme for the construction of new trunk roads, and the fact that if industrial activity and export markets are to be maintained at a sufficiently high level to provide the expected improvement in living standards, then the need for transportation will grow, and there will be room for expansion in both rail and road goods traffic.

As regards fuel consumption by goods vehicles, the dominant feature, of course, has been the steady growth of the diesel engine. In 1938, diesel-engined vehicles represented about 22 per cent of trucks over 3 tons U.L.W. or 1·8 per cent of

the total commercial motor vehicles. Today the proportion is about 40 per cent of vehicles over 3 tons or nearly 7 per cent of the total, the number in use having increased about eight times. (See Chart VIII). The principal reason for this trend is undoubtedly the heavy burden of fuel taxation which makes fuel costs so high that, according to calculations made by *The Commercial Motor*, a diesel vehicle affords savings of 12–15 per cent on operating costs, a margin which soon justifies the additional first cost compared with a petrol-driven vehicle when high mileages are possible. A further incentive is the superiority of the diesel engine for load-carrying purposes, and the fact that the less frequent need for maintenance enables a higher proportion of double shifts to be employed.

Today more than 75 per cent of the new heavy trucks (over 4 tons) being delivered in the U.K. are diesel vehicles, and so also are well over half of those in the 3–4 ton category. Smaller diesel engines are now being satisfactorily produced, and an increasing proportion of the new 2½–3 ton vehicles are now diesel-powered. Whether this trend will spread into the lighter category, and especially into the light delivery van class is doubtful. In the first place, a satisfactory engine for this purpose has yet to be produced, and secondly, the small operator, with perhaps only one or two vans, may find some difficulty with maintenance and servicing, which, although needed less frequently than with a petrol engine, requires skilled and specialist labour. No doubt, as long as the use of diesel vehicles is economically attractive, development of the smaller types will continue. Taxation is the key to the situation, whether it be adjusted to lessen the disparity in fuel cost per mile between petrol and diesel, or whether it be maintained at the same level for both fuels, but reduced. In either case the use of a diesel vehicle presents a less attractive economic proposition than under present conditions.

Agricultural Tractors

The tractor population of the U.K. is more dense than that of any other country in the world, there being 1 tractor for every 50 acres of arable land, compared with 1 for 100 acres in the United States and 1 for 250 in France. The number of tractors in the census of Janauary 1954 was 460,000 compared with a pre-war total of only 55,000.

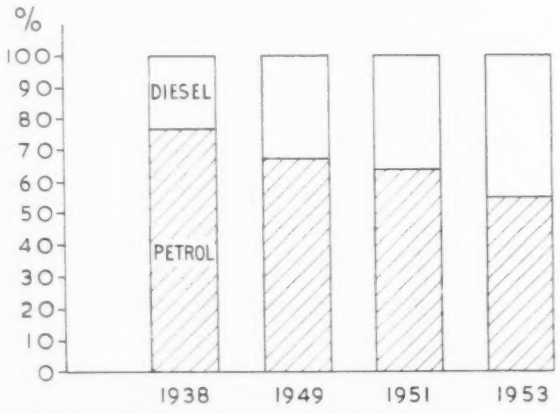
Until 1948 the increasing numbers of tractors were largely a result of the continued necessity of producing as much food as possible at home, in order to keep imports at a minimum. Since then, however, there has been an added necessity owing to the high cost of labour and of maintaining horses, and also to the shortage of labour. (See Chart IX). Not much significance as far as fuel consumption is concerned can be attached to present-day changes in tractor population since, although new tractors are purchased, those which they replace are kept registered and used as reserves or to supplement the new vehicles in periods of peak utilization.

Taxation again has played an important part in deciding the type of tractor to be employed in the U.K. Petrol when used in tractors bears the same duty as for road vehicles, vaporizing oil and diesel fuel used for this purpose are not taxed at all. The absence of a suitable diesel engine for any but the very largest tractors led to the development of the vaporizing oil type. Recent years, however, have seen a marked change in the position, and the availability, at comparatively low cost, of a suitable diesel conversion unit has seen the beginning of what is expected to be a progressive decline in the use of kerosine tractors. In the agricultural census of January 1954 the number of diesel tractors was established at 56,600. This was the first time that an analysis of tractors by fuel types had been made, but some idea of the rate of progress may be gained from the fact that diesel fuel consumption by agricultural power units almost trebled between 1951 and 1954, rising from 62,000 tons to about 180,000 tons. This increasing trend is expected to continue, while demand for vaporizing oil is likely to decline steadily from its present level of 700,000 tons to about 450,000 tons in five years' time.

Estimated Future Trends

In summarizing the position in respect of the main groups as it was in 1938 and 1954 and as it might be in 1958 it is necessary to emphasize that nearly all the figures shown in Table II are estimated, since there is little factual information relating to end uses of petroleum products. The vehicle numbers for 1954 and 1958 are estimates of the average numbers in use throughout the year.

Chart VIII
Fuel Classes of Trucks over 3 tons U.L.W.



Taking private cars first, it is suggested that the numbers in use will increase steadily during the next four years, but that the increase in fuel consumed will be relatively lower, owing to the increasing numbers of cars used solely for pleasure.

In the field of public passenger transport, the marked trend towards diesel vehicles indicates that in 1958, although there is likely to be a small increase in the total number of buses and coaches, total fuel consumption will have begun to decline.

The same trend is in evidence with commercial vehicles. Although petrol-engined types in the lighter categories are still expected to increase in numbers, the average fuel consumption of both petrol and diesel vehicles is expected to show a decline.

TABLE II

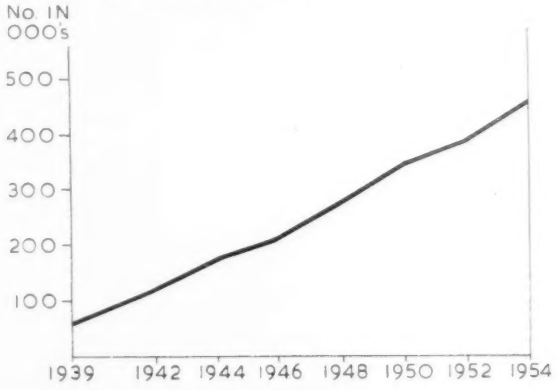
VEHICLE POPULATION AND FUEL CONSUMPTION IN THE U.K.

	1938		1954		1958	
	No. in Use 000's	*Fuel Mln. Glns.*	*No. in Use* 000's	*Fuel Mln. Glns.*	*No. in Use* 000's	*Fuel Mln. Glns.*
Private Cars ...	1984	650	3000	720	4100	950
Buses—Petrol ...	33	135	14	37	8	21
Diesel ...	17	77	58	220	66	235
Trucks—Petrol ...	490	495	908	710	926	680
Diesel ...	9	25	73	150	154	260
Tractors—Petrol ...		N.A.	100	42	99	35
Diesel ...	55	1	70	47	160	105
Kerosine ...		42	305	180	280	140

It seems likely that the number of diesel tractors will continue to grow. It is felt that the number of kerosine tractors will remain at a fairly high level but that there will be a decline in their intensity of use and, in many cases, they will be held in reserve for use at peak periods of activity such as that which the agricultural industry is now experiencing.

Perhaps the outstanding conclusion which can be drawn is the apparent lack of prospects for any noteworthy increase in demand for motor gasoline; if the current dieselization trend spreads to the smaller commercial vehicle, and the cost of private motoring remains as high as it is today, we may even find in a few years' time, that the modest increase in gasoline demand afforded by the growth in the car population may be insufficient to offset the decline in consumption by commercial vehicles. Whether any solution can be found to the

Chart IX
Agricultural Tractors in Use in the U.K.



technological problems which this, coupled with the increased diesel consumption, would present, is no doubt receiving the consideration of those most concerned. Let us hope that those responsible for the fiscal influence on the situation are also fully aware of its implications.

Discussion

Opening the discussion, **G. A. Claydon** first complimented Mr Strugnell on a most interesting paper and then went on to suggest that the large-scale expansion of motor car production facilities in the U.K. would make inevitable a considerable growth in car population. It was expected that a 60 per cent increase in output would be achieved by 1960 and that the vast majority of the vehicles produced would be gasoline-propelled. The bulk of the additional cars would be owned by private motorists and it seemed likely that average gasoline consumption per vehicle would be barely maintained and might even be lowered with increased engine efficiency and greater congestion on the roads. In spite of the development programme in the motor industry, therefore, there appeared to be no immediate solution to the product out-of-balance position in this direction. Moreover, such small tax concessions as were feasible were unlikely to have any substantial effect upon consumption.

Mr Claydon thought that the intrusion of the diesel engine into the private car and light van fields would be very limited but that the consumption of diesel oil would continue to increase with the emphasis upon diesel power units in public service and commercial vehicles and in light of the rail dieselization programme. With the prospect of a relatively small increase in gasoline consumption either technological means of increasing the diesel yield must be found, wasteful uses of gas oil for steam raising and in gas industry cracking plants must be avoided, or diesel specifications must be stretched to include other light distillate fuels such as aviation turbine gasoline. The only alternative to such measures would seem to be increased refinery throughputs.

Mr Claydon further suggested that similar light fractions might be used in gas turbines, in whose development substantial progress had recently been made in the U.S.A.

C. Chilvers continued the discussion by expressing his belief in the importance of the questions raised in Mr Strugnell's paper to the future planning of the industry. Forecasting had as vital a part to play in the oil industry as had fundamental research on the technical side.

W. H. Davies, who regarded the purchase price of a car as the most important factor affecting car ownership and operation, thought that once a motorist had purchased his car he made full use of it, irrespective of the price of fuel, and endeavoured to reduce the cost per mile by filling his car to capacity. He wondered whether a sizeable reduction in the purchase tax on vehicles would result in a proportionate increase in the number of private cars.

In reply, Mr Strugnell said that there was still a very healthy demand for cars and that a reduction in purchase tax, while it might increase the number of potential car owners, would merely mean a lengthening of the queues for the lower-priced cars.

After agreeing with Mr Strugnell on this point, **Mr Moreton** suggested that the future scrappage rate might be held at the level of 50,000 vehicles per annum which had obtained over the last three years and that some frustrated exports might be diverted to the home market. If either or both of these possibilities occurred, gasoline consumption would be much greater than forecast and this Mr Moreton believed to be the likely development.

Mr Strugnell agreed that this was a possibility but pointed out that the rate of scrapping during recent years had been phenomenally low in view of the age structure of the car population. He considered that an admittedly arbitrary rate of 210,000 in 1958 was more realistic. On this basis, the car population would be 4,100,000 in that year with a possible error of 100,000 either way.

S. D. Colwell supported Mr Davies in his contention that the price of fuel was of comparatively minor importance to the motorist once he was in possession of a car. He felt that the reasons for the decrease in the average annual mileage per vehicle and per private motorist lay deeper, and wondered whether these lower mileage levels would set the pattern for the future.

Mr Strugnell reiterated his belief that the car owner was only too conscious of fuel cost. It was frequently the factor which determined whether a motorist, particularly when travelling alone, made a journey by public transport or by private car.

In answer to a question on relative private and business mileage and the apparently major effect which private motoring had exerted upon average vehicle mileage, Mr Strugnell said that he understood that about 75 per cent of cars running were business-assisted vehicles whose annual mileage might vary from 8000 to 20,000 miles. The important point was that the whole of the increase in population was attributable to private cars with an average annual mileage of from 4000 to 4500 miles. When there was an annual increase of 300,000 in cars of this type, average vehicle mileage was inevitably "scaled down".

W. S. Ault then returned to the subject of the effects of purchase tax upon car sales. He disagreed strongly with the opinions previously expressed. The potential car owner tended to allocate a set sum for car purchase. The result was that for a given sum he now buys a smaller car than he would have bought in similar circumstances in 1938. The typical professional man's car was now one of 1200–1500 cc., or even 800 cc., capacity. In the absence of purchase tax, he would tend to buy a 2-litre model as does his opposite number on the Continent. Such a changeover would increase gasoline consumption by reducing mileage per gallon from 32–35 m.p.g. to 25–28 m.p.g. Business firms were similarly deterred by purchase tax from purchasing the more highly-powered cars which they would otherwise prefer.

Mr Ault assessed the annual fuel bill of the average motorist to be about £50 and found it difficult to believe that he would cut his annual mileage from 9000 miles to 6000 miles for the sake of a £25 saving. He thought the appalling state of the roads in Britain was a factor of much greater importance. Private motorists would drive much further at weekends if they could put in a reasonable number of miles to the hour. They were not necessarily deterred from motoring by the weight of traffic but they did not travel as far as they would otherwise do. Similarly a business man travelling to, say, Birmingham refrained from using his car for a journey which under present conditions would take him from three to three and a half hours. When the road situation was materially improved, average mileages would rise very sharply indeed.

Although agreeing to some extent with Mr Ault's remarks on purchase tax, Mr Strugnell still maintained that fuel costs were extremely important to the average motorist and that economics in fuel consumption were a major factor in his choosing a car. Thus in choosing between two comparable cars, a price advantage might well be offset by the higher fuel consumption of the cheaper car. What were the predominant factors influencing the choice of car was, however, inevitably a matter of opinion.

J. M. Clark approached the subject from a fresh standpoint. He considered that dealer sales of motor spirit in the last few years had followed the general level of economic activity in the country. In mid-1953 when industrial production fell off, dealer sales had also declined. Consumption was not in fact related to the supply of new cars but to economic factors. In the future, if production, business, and trade were to fall off, car sales would decline and motor spirit consumption would dry up not only in the private sector but in the commercial sector also.

One further aspect which Mr Clark felt worthy of consideration was the relative consumption of premium and standard grade petrols and the fact that premium grades appeared to be steadily gaining over the standard grades.

Mr Strugnell attributed the growing predominance of premium sales to the fact that the rise in consumption was due to the increased demand by private motorists and to the fact that smaller commercial vehicles were now being fitted with what were in fact private car engines, using to an increasing extent premium petrol.

Speaking "off the cuff", Mr Strugnell said that the increase in consumption in 1953 and the even sharper increase thereafter were closely related to the big increase which took place in private cars in 1953 and the even larger increases since then. Although there had been a slight recession in 1952 and sales to commercial consumers had declined, dealer gasoline sales had continued to increase.

D. C. Ion compared conditions in the U.K. and in the U.S.A. Population was less concentrated in the U.S.A. than in the U.K., with the result that public transport was a less convenient mode of travel. There were as many cars in Los Angeles and its environs as in 23 of the 48 states. In this area, a population of four million lived within 50 miles of central Los Angeles, whereas in London a similar number were concentrated within an area whose radius was a mere 5–10 miles. In so congested an area as London public transport was the more convenient and feasible mode of travel. This was far from being the case in Los Angeles. Thus to talk of income levels and ignore population densities was not the whole story.

Mr Strugnell agreed that because of this contrast between the U.K. and the U.S.A. it was unlikely that a ratio of one car to every four persons would ever be achieved in this country.

It was pointed out that in countries such as France, where population was scattered and distances greater than in the U.K., the car population still remained low because of the lower level of economic prosperity.

Mr Colwell remarked upon the comparative cheapness of gasoline in the U.S.A. and suggested that a very large increase in consumption would take place in the U.K. if the British price were comparable.

When the question of the additional initial expenditure involved in the purchase of a diesel-powered car was raised, Mr Ault said that even at the present stage of development the difference in cost was not alarmingly great. He believed that for a reasonably-sized car it was about £100 and in one case had been reduced to as low as £60, a comparatively low percentage increase in a car costing, say, £550 without tax.

The meeting closed after **Dr Ridler** had proposed a hearty vote of thanks to Mr Strugnell, in which he expressed the hope that the intensity of the discussion had compensated the speaker for the rather low attendance.

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Three ships fuelling at the new Esso bunkering terminal at Algiers. The twelve marine fuel and diesel storage tanks have a total capacity of approximately 55,000 tons of fuel. With these facilities Esso and the terminal operator Cie Venture-Weir (S.A.) are able to receive full loads of oil from large tankers and to provide a complete range of Esso Marine Fuel Oils for steamers and motorships of unlimited size.

Petroleum and Engineering

At the Engineering, Marine and Welding Exhibition, which incorporated the Foundry Trades Exhibition, held in London during the first half of September, equipment for the petroleum and allied industries was much in evidence, as were also the lubricants and other petroleum products available for the machines and appliances exhibited.

It is not possible in the space available to do more than make brief reference to some of the exhibits, and the following notes are of necessity confined to Member-Companies of the IP.

Alley & MacLellan Ltd.—Flow line valves for the oil industry complying to BS, ASA and API requirements, together with all types of valves for water, air, or gas.
Audley Engineering Co. Ltd.—Lubricated plug valves for petroleum and other pipelines and special lubricants for them. Also "Lubecoating", for friction reduction, and remote-controlled, power-operated valves.
Babcock & Wilcox Ltd.—Various types of boiler, including the "Steambloc", an automatic oil-fired boiler for steam or hot water. Also a display of the development of Babcock boilers.
English Electric Co. Ltd.—The Diesel Engine Division showed examples of its activities, including a self-contained mobile diesel generating station and a number of diesel units of various types.
The exhibit of the Electronics Division included induction heaters, motor controllers, and control stations.
In the Welding Section arc welding electrodes and equipment were displayed.
Esso Petroleum Co. Ltd.—Literature and samples relating to the Company's products were on show and their uses were illustrated.
Evershed & Vignoles Ltd.—Remote control gear and indicators; electronic repeaters; testing sets; ohmmeters; measuring instruments.
The Fuller's Earth Union Ltd.—In the Foundry Sections, the Company's moulding sands were demonstrated. Also shown were examples of fuller's earth for oil decolorizing and other purposes.
General Refractories Ltd.—A comprehensive range of refractories recommended for use in many types of industrial furnaces.
Germ Lubricants Ltd.—Samples of industrial lubricating oils and greases, testing instruments, and bulk handling equipment.
J. & E. Hall Ltd.—Refrigeration compressors and examples of other manufactures, including a model of an escalator.
G. A. Harvey & Co. (London) Ltd.—Sheet metal and steel plate work; office and works equipment; galvanizing.
Hayward, Tyler & Co. Ltd.—Dynamometer motor; borehole pump; oil refinery or pipeline pumps; oil tanker cargo pump; chemical pump.
Imperial Chemical Industries Ltd.—Tubes and plates for oil refinery plant and other special uses, together with specimens of alloys, etc., were shown by the Metals Division. The Nobel Division exhibited silicones and silicone rubbers for gaskets, seals, etc.
Richard Klinger Ltd.—Jointing materials resistant to oils, solvents, acids, and for other purposes: cocks for the oil industry, diesel indicators, etc., liquid level gauges; valves.
Lincoln Electric Co. Ltd.—Automatic welding equipment, generators, electrodes, and accessories were shown in the Welding Section.
Metropolitan-Vickers Electrical Co. Ltd.—Various generating equipment, including a marine auxiliary set, a high pressure cylinder for a marine turbine, rotor turning gear, and voltage regulator. Resistance and arc welding machines were displayed in the Welding Section.
The Mond Nickel Co. Ltd.—Metals and alloys, including spheroidal graphite cast iron, rhodium plating, and nickel steel.
Monsanto Chemicals Ltd.—The exhibit featured Investment X, a development in the use of Silester O in invested shell mouldings.
C. A. Parsons & Co. Ltd.—A high pressure cylinder for a 3-cyl turbine and other parts; turbine blading of various types; electrical transformer components.
F. Perkins Ltd.—Various industrial and marine diesel engines.
Power Petroleum Co. Ltd.—BP industrial and marine lubricants.
A. Reyrolle & Co. Ltd.—Switchgear, commutator motors, and welding generators.
Rubery Owen & Co. Ltd.—Foundry equipment, including moulding machines, pulleys, etc.
Ruston & Hornsby Ltd.—Industrial and marine diesels of various types, a gas engine for oilwell drilling, an industrial gas turbine, and a mine locomotive.
Serck Radiators Ltd.—Heat exchange equipment for engines and gas turbines and tubes for condensers, etc.
Shell-Mex and B.P. Ltd.—Two interesting demonstrations were given. The first demonstrated the causes and cures of poor combustion when using heavy fuel oil. The second showed the development of anti-corrosion lubricants.
Sigmund Pumps Ltd.—Pumps for industrial and marine use and for public works, site drainage, etc.
Stewarts and Lloyds Ltd.—Tubes of all descriptions, joints and coupling, valves and fittings.
Stothert & Pitt Ltd.—Pumps for fuel and lubricating oils and for highly viscous liquids.
John Thompson Ltd.—Water-tube boilers, condensers (including oil stripper unit), and a twin bed de-ionization unit.
The United Steel Co. Ltd.—Marine and industrial lubricating oils and greases.
Vacuum Oil Co. Ltd.—Marine and industrial lubricating oils and greases.
Wakefield Group—Industrial and marine oils and greases and lubrication equipment.
G. & J. Weir Ltd.—A large flow model of the Weir closed-feed system for ships.
Williams & James (Engineers) Ltd.—Starting equipment, reducing and relief valves, filters, and compressors.
The Yorkshire Copper Works Ltd.—Solid drawn tubes in various metals and alloys, for condensers, coolers, tanker heating coils, bottled gas installations, and general service pipelines.

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NEW JERSEY PRICE TROUBLE

According to a report from the U.S. industrial correspondent of "The Financial Times", the major U.S. oil companies are threatened with a ban on their sale of petrol in the State of New Jersey if it should be proved that they have been granting secret rebates to dealers to encourage them to cut prices.

The report states: "Such rebates were made illegal by a new law last year. The law itself, and the current investigation into whether it has been violated, is the result of attempts to end the perennial 'gas' price wars in New Jersey.

"Such price cutting contests by petrol stations in the State have gone on intermittently for years, with the result that motorists from time to time have been able to buy petrol for several cents less than in surrounding areas.

Main Causes

"Several factors have created the situation, including the fact that major companies have large refineries in New Jersey which becomes a ready outlet for any surplus stocks, that the State is one of the major consumers of petrol for a vast commercial and private vehicle traffic, and that it has become a kind of melting pot for the petrol business.

"Legislation to try and bring some order into the situation was enacted last year, chiefly at the behest of independent owners of petrol stations not affiliated with major oil companies. They complained that discount policies by the big firms were driving them out of business. These interests have charged the big firms with making secret rebates on wholesale prices, trying to replace private stations by company-owned stations, and aiming to establish a petrol monopoly.

"The big companies have denied having such aims and have blamed one another and the independent producers for creating price-war conditions. Price wars have continued in spite of the preventive legislation, and the State recently inaugurated hearings in which Esso, Standard Oil and 11 other companies were the target.

"Meanwhile, petrol price wars in New Jersey and elsewhere are under the scrutiny of Congress".

Notes of the Month

New Gas-from-Oil Agreement

An agreement has been signed between the British Petroleum Company Ltd. and the South Eastern Gas Board for the production of town gas from oil in a plant to be erected by the Board at the Company's Kent Oil Refinery, Isle of Grain.

The British Petroleum Company is granting a long lease of a site which will be sufficient for the construction of oil gasification plant up to a daily capacity of 80 million cubic feet. If the plant is developed to this extent it will be equal in output to the largest gas works in the area.

In the first stage gas will be produced on the scale of 15–20 million cubic feet a day, with a saving of about 300,000 tons of coal a year. The quantity of oil to be used in the first stage is estimated to be 60–70,000 tons a year.

Orders will be placed by the Board as soon as possible for four oil gasification units and these should be completed in two to two-and-a-half years. Experiments have shown that the Segas plants developed by the Board can convert into gas a wide range of oil products. The agreement, which is for a period of 20 years, is intended to lead to a close working relationship with the refinery in order to use whatever oil products are available to the best advantage of both parties.

Mains will be laid from the Isle of Grain to Strood in Kent to feed the gas into a trunk main system through which gas will be distributed south of the Thames from Sittingbourne in the east as far as Guildford in the west.

The new plant will be the first in the country to use oil products on a large scale as the only material for gas production. It may prove to be significant as the point of departure from the long tradition of the gas industry in relying on coal as its main raw material.

New Tanker Building Programmes

Bookings for 34 berths have recently been placed by Shell as part of a new tanker building programme. Twenty of the vessels are to be built in the United Kingdom and 14 at five yards in Holland. Deliveries will begin in 1958 and are expected to be completed by 1960.

It is expected that the new ships will be divided equally between the 18,000 and 32,000-dwt classes.

The Esso Petroleum Company has also embarked on a programme for six 36,000-dwt tankers, and orders have already been placed. Two ships have been ordered from Vickers-Armstrongs Ltd., to be built at Newcastle upon Tyne for delivery in 1958, and the remaining four ships have been ordered from German yards—three to be delivered in 1957 and the last one in 1958.

These tankers, the largest so far to be built for the Esso fleet, are needed for service at the earliest possible date. There is only a limited number of berths suitable for these large ships in British yards and these are fully occupied by existing orders.

B.S.I. Birmingham Sales Office

With the co-operation of the Birmingham Chamber of Commerce, the British Standards Institution has now opened a sales office in the headquarters of the Chamber at 95 New Street, Birmingham, 2.

The B.S.I. has for a long time had a branch office in Manchester and this has shown that such a facility meets a very real local need. The new office in Birmingham will maintain a full and up-to-date stock of all British Standards and associated publications, which will help to meet more effectively the growing demand for British Standards from industry and commerce, and from students and technicians.

The New Street office will operate at all normal working hours. In addition to the sales counter, it will provide facilities for the inspection of British Standards by interested persons.

Normal reference facilities will continue to be available at the Public Library in Birmingham, as in many libraries in other parts of the country.

Assam Drilling Record

A report from Digboi indicates that Assam Oil Company's well No. 7 at Nahorkatiya was drilled to a depth of 10,350 feet in 48 days (26 June to 13 August), thus establishing a drilling record for India. No. 8 well in the same area took 50 days to reach a similar depth. The report compares drilling times in the early days in Digboi—No. 1 well took 14 months, from September 1889 to November 1890, to reach 662 feet; No. 3 well, which is still producing, took nearly 2 years to reach 752 feet, from July 1891 to June 1893.

Television for Shell-BP Fleet

All 14 vessels of the Shell-Mex and B.P. Ltd. coastal fleet are to be fitted with television. The sets will be 17-inch-screen models capable of receiving both B.B.C. and Commercial TV programmes.

The first installation, on board M.V. *Shell Director*, has just been completed and other vessels will be fitted as soon as they return to port for overhaul.

This is the first time that an entire fleet has been equipped by the owners, at their expense, for the benefit of personnel.

New Shell Chemical Company

Shell's chemical manufacturing and marketing activities in the U.K. and Eire are to be concentrated in one company, to be known as the Shell Chemical Co. Ltd. The decision to form this new Company has been taken in view of the increasingly rapid growth of Shell's chemical activities and in order to facilitate plans for further expansion.

The new Company will take over the activities of Shell Chemical Manufacturing Co. Ltd. and Shell Chemicals Ltd. Petrochemicals Ltd., which was recently acquired by Shell Chemicals Ltd., will continue its chemical manufacturing and marketing activities as a separate entity.

The Board of Shell Chemical Company Ltd. will be as follows: chairman, F. A. C. Guépin; vice-chairman, W. F. Mitchell; managing director, L. H. Williams; commercial director and deputy to the managing director, G. H. W. Cullinan, previously general manager of Shell Chemicals Ltd.; executive director, manufacturing, E. Le Q. Herbert, the managing director of "Shell" Refining and Marketing Company Ltd. The other directors of the company will be J. W. Platt; Sir Robert Robinson, O.M., F.R.S.; A.D. Koeleman; Dr M. A. Matthews and F. Mackley.

Until further notice the marketing activities carried out hitherto by Shell Chemicals Ltd. and by Petrochemicals Ltd. will continue to be directed from their present addresses.

New Esso Distribution Depot

A new distribution depot with a storage capacity of 216,000 gallons has been opened by Esso Petroleum Co. Ltd. at Cromwell Road, Cambridge. The plant is one of a series now being built as part of the Company's plan to improve its distribution methods. Supplies will be brought to the depot by road tanker from the Company's ocean terminal at Purfleet.

New Plymouth Terminal

The opening of a new terminal at Plymouth marks an important step in the plans of Western Petroleum Products Ltd., a company owned jointly by Vacuum Oil Co. Ltd. and local interests in Plymouth, for distributing Mobilgas and Mobil Diesel in Devon and Cornwall. The company was formed to construct, own, and operate the terminal and to sell and distribute the products, which are manufactured at Vacuum's Coryton refinery.

The terminal has a capacity of nearly half a million gallons and supplies are brought by coastal tankers to the wharf and then carried to the four main storage tanks by pipelines 4200 feet long. Two road tankers can be loaded simultaneously by electrically operated pumps at a rate of 250 gallons a minute.

New Storage Depot at Durban

South Africa's first independent bulk liquid storage installation has recently come into operation at Durban. Run by Island View Storage (Pty) Ltd., the new depot provides facilities for the import, export, and storage of a variety of liquid commodities, including lubricating and fuel oil. Managing director of the operating Company is P. H. Moore, B.Sc., A.M.I.Chem.E., F.Inst.Pet.

Shell Plea to British Shipyards

"No-one, except perhaps the shipbuilders themselves, is more anxious to see a flourishing and competitive shipbuilding business in this country than the owners, from a personal, commercial, and patriotic point of view, but please don't strain our loyalties too far". This plea to British shipbuilders was expressed by A. S. C. Hulton, managing director of Shell Tankers Ltd., at a recent launching ceremony.

The occasion was the launching of the 18,000-dwt tanker *Heldia* from Swan Hunter's shipyard at Wallsend-on-Tyne, the ceremony being performed by Mrs T. Clifton Webb, wife of Thomas Clifton Webb, Q.C., High Commissioner for New Zealand in the U.K.

Mr Hulton had opened his speech by stating that this launching put the tonnage launched by Swan Hunters for the Shell Group at over 400,000 tons and nearly half of this had been delivered since the second world war. He then went on to speak of the present position in British shipyards and said that it now seemed that Continental yards, in spite of their higher cost of steel, were willing and able to deliver ships at cheaper prices, and to write better contracts, than could be obtained in the United Kingdom.

"The dangers of the future are sometimes apt to be obscured by the prosperity of the present," said Mr Hulton, "and yet it is good times such as are enjoyed today that present the ideal opportunity to introduce safeguards against the dangers of the future". This was a problem which could better be tackled collectively than individually and now was the time for the shipbuilding industry to build up its defences.

"Shell" Refining and Marketing Co. Ltd.

The reconstitution of the Board of Directors of "Shell" Refining and Marketing Co. Ltd., was recently announced.

J. W. Platt is to be the new chairman of the Board and E. Le Q. Herbert has been appointed managing director.

The other directors are to be: J. A. Berriman, J. Grant, F. Mackley, C. R. Middleton, F. J. Stephens, R. W. J. Smith, and W. S. Thompson.

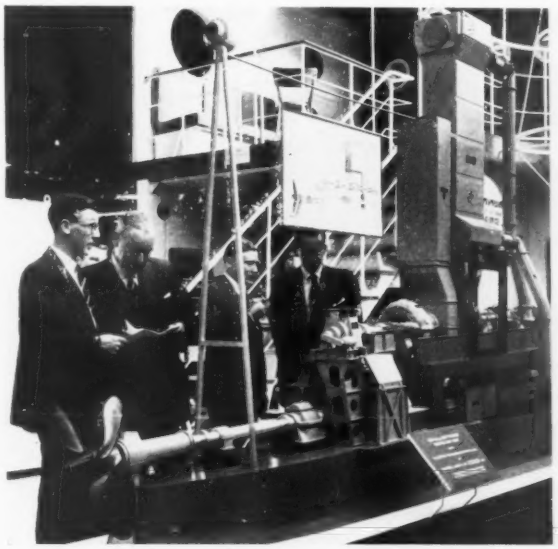
New Gas Turbine Unit for "Auris"

Among the marine exhibits of the British Thomson Houston Co. Ltd. at the recent Engineering, Marine, and Welding Exhibition was a model of the single 5500-h.p. gas turbine unit which is to replace the existing power unit of a 1200-h.p. gas turbine and three diesel alternators aboard the 12,250-dwt Shell tanker *Auris*.

The design and layout of this new installation is the work of the British Thomson-Houston Co. and of Cammell Laird and Company, in collaboration with Shell's Marine Research and Development Department.

The new gas turbine unit will be an open cycle type with intercooler and heat exchanger.

Air, inhaled from the atmosphere, passes through the low pressure compressor, the intercooler, the high pressure compressor, and the heat exchanger to the combustion chamber, where it is heated by the burning petroleum fuel. The combustion products expand first through the high pressure turbine, which drives the high pressure compressor only, and then through the low pressure turbine, which in addition to driving the low pressure compressor, produces the propulsive power. From the low pressure turbine the products of combustion flow through the heat exchanger,



A Shell photo

A 12-ft model of the new Auris *power unit on view at the Exhibition.*

and then an exhaust gas boiler, in which steam is generated, to atmosphere.

The main particulars are:—

Design ambient temperature	75° F (24° C)
Turbine inlet temperature	1200° F
Design output	5500 b.h.p.
Heat rate	9100 B.t.u. b.h.p. per hour
Waste Heat Boiler	
Steam pressure	50 lb sq. in. gauge
Evaporation	5000 lb hr
High Pressure Turbine Shaft	
Speed	5800 rev min
No. of compressor stages	16
No. of turbine stages	5
Low Pressure Turbine Shaft	
Speed	3840 rev min
No. of compressor stages	12
No. of turbine stages	8

The output and heat rate ignore the power obtained from the waste heat boiler.

The new machinery will incorporate double reduction gearing with hydraulic means for reversing the direction of the propeller shaft. The propulsion system will also provide power for auxiliary purposes both at sea and while in port.

Forthcoming Meetings

THE INSTITUTE

(At 26 Portland Place, London, W.1, 5.30 p.m.—tea 5 p.m.)

Preflame Reactions in a Diesel Engine. Prof. F. H. Garner, O.B.E., M.Sc., Ph.D., F.R.I.C.; G. H. Grigg; Prof. F. Morton, D.Sc., Ph.D., F.R.I.C., and W. D. Reid, B.Sc., Ph.D. **9 November**

Statistics as an Aid to Specification. G. W. Sears, M.A., A.F. Inst. Pet. **14 December**

IP FAWLEY BRANCH

(At Esso (Fawley) Recreation Club, Holbury, 7.30 p.m.)

The Application of Electronics to the Oil Industry. J. M. Keating, B.Sc. **18 November**

New Developments in Refining Processes. W. N. Hoyte, B.A. (Cantab.), M.I.Chem.E. **16 December**

IP LONDON BRANCH

(At 26 Portland Place, London, W.1, 6 p.m.—tea 5.30 p.m.)

Operation of a Tanker Fleet. C. A. Samuels. **22 November**
Film Evening (At Shell-Mex House) **16 December**

IP NORTHERN BRANCH

(At Engineers' Club, Albert Square, Manchester, 2, 6.30 p.m.)

Annual Dinner Dance. (At Midland Hotel, Manchester) **11 November**

Solid Lubricants. E. A. Smith. **15 November**

Film Show and Hot-Pot Supper. (At Warner's Theatre, 5.30 p.m.) **10 December**

IP SCOTTISH BRANCH

(At N.B. Station Hotel, Edinburgh, 7 p.m.)

Fuel Oil Utilization. (Joint meeting with Institute of Fuel, Scottish Section) **8 November**
Off-shore Drilling. B. F. Saurin. **15 December**

IP SOUTH-EASTERN BRANCH

(At King's Head Hotel, Rochester, 7.45 p.m.)

The Important End of the Pipeline. A. D. Butchart.
Film—New Detergents. **6 December**

IP SOUTH WALES BRANCH

(At Training Centre, National Oil Refineries, Llandarcy, 5.30 p.m.)

Brains Trust. **1 December**

IP STANLOW BRANCH

(At Grosvenor Hotel, Chester, 7.30 p.m.)

Refinery Utilities Symposium: Steam, Electrical Power, Water. D. W. Smith, B.Sc.; W. S. Morris, M.I.E.E.; G. W. Power, M.Eng., A.M.I.C.E. **16 November**

Film Show. (At Tatler Cinema, Chester, 2.30 p.m.) **27 November**

The Shell Hydrodesulphurization Process. (Joint meeting with Royal Institute of Chemistry). **14 December**

ECONOMICS AND OPERATIONS GROUP

(At 26 Portland Place, London, W.1, 5.30 p.m.—tea 5 p.m.)

Oil Gas for Town Use. J. E. Davis, O.B.E., F.R.I.C., M.Inst.Gas.E. **30 November**

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OTHER SOCIETIES

Distillation of Liquid Hydrogen. Prof. E. S. Sellers and D. R. Augood. **Transient Behaviour of Plate Distillation Columns.** J. F. Davidson. The Institution of Chemical Engineers, at The Geological Society, Burlington House, London, W.1. Commencing 5.30 p.m. **6 December**

Power, Population, and Productivity. Melchett Lecture for 1955. Dr A. Parker, C.B.E., Meeting of the Institute of Fuel to be held at The Institution of Civil Engineers, Great George Street, London, S.W.1. 5.30 p.m. (tea 5 p.m.) **7 December**

The Performance Characteristics of 6-inch-diameter Stedman Packing under Reduced Pressures. Parts I and II. D. G. Cerigo, P. J. King, and Prof. F. Morton. The Institution of Chemical Engineers, Midlands Branch, Birmingham, The Midlands Institute. 3 p.m. **10 December**

Fuel Forum—A Discussion on Mutual Problems. Joint meeting of the Institute of Fuel with the Institution of Heating and Ventilating Engineers. To be held at the Exchange and Engineering Centre, Stephenson Place, Birmingham. 6 p.m. **14 December**

CARBURATION AND OTHER FUEL SYSTEM PROBLEMS

A paper entitled "Some notes on carburation and other fuel system problems" by C. H. Fisher is to be read before the Automobile Division of the Institution of Mechanical Engineers at 1 Birdcage Walk, London, S.W.1, at 5.30 p.m. on Tuesday, 13 December. The Council of the Automobile Division has extended an open invitation to members of the IP to attend and to take part in the discussion, and preprints of the paper are obtainable from the Secretary of the IME on request. Refreshments will be served from 5 p.m.

THE MANCHESTER SYMPOSIUM

The 1956 Manchester Symposium, sponsored by the local branches of the Chemical Society, the Institute of Petroleum, the Royal Institute of Chemistry, and the Society of Chemical Industry, is being organized by the Northern Branch of the IP. The subject will be lubrication and the meeting will take place at Manchester University on 19 April 1956.

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STUDENT'S PRIZE

The Council of the Institute of Petroleum has decided to award annually a Student's Prize to the value of £10 for the best paper submitted by a student during the year. The conditions under which the award will be made are:

1. Candidates should be student members of the Institute and the subject of their papers should come within the scope of the Institute's activities and be suitable for publication by the Institute.
2. Papers should not exceed 5000 words in length and should be accompanied by line drawings or photographs where necessary.
3. Papers should preferably be in typescript (two copies are desirable) but may be in manuscript if legibly written. They should be submitted to the Institute not later than 30 April in any year.
4. The name and address of the author should not appear anywhere on the paper but should be submitted on a separate sheet of paper.
5. The first award will be considered in 1956, but the Institute reserves the right to withhold the prize in that or any other year in which no paper is considered to merit an award. The decision of the Council of the Institute is final.

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SITUATION WANTED

Engineer, 38, A.M.I.Mech.E., A.F.Inst.Pet., with experience in engine laboratory and field testing of I.C. engine fuels and lubricants, fuels and lubricants for marine C.I. engines, industrial lubricants and plant surveys and general technical service, seeks a position of responsibility in the petroleum industry or as Lubrication Engineer to a large industrial undertaking. Please reply to Box No. 1102. IP Review.

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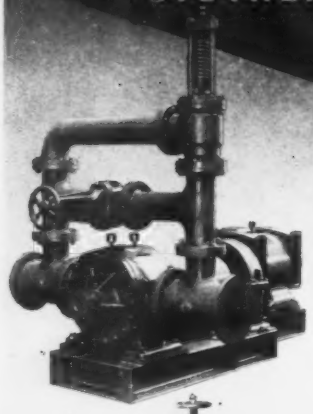
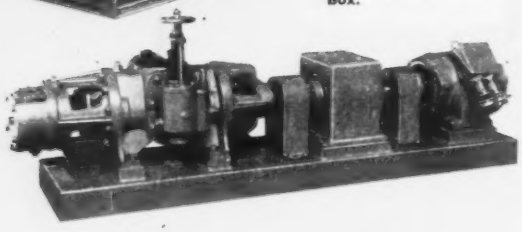


(Left)
Positive Acting Rotary Displacement Pump for the handling of Molasses and viscous fluids, electrically driven through totally enclosed Reduction Gear Box.

(Below)
Positive Acting Screw Displacement Spirit Pump, electrically driven through Wall Box.



(Right)
Positive Acting Screw Displacement Spirit Pump specially designed for fitting to Road vehicles.

(Below)
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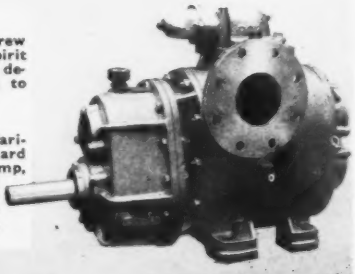

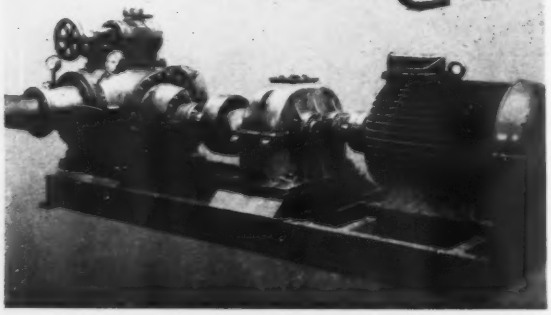

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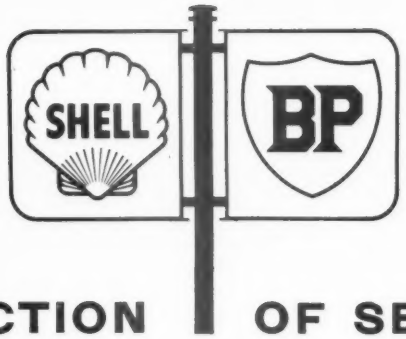

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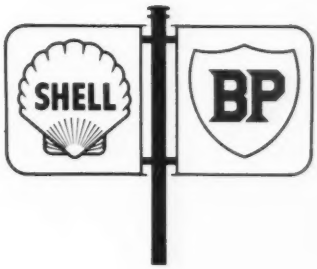

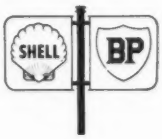

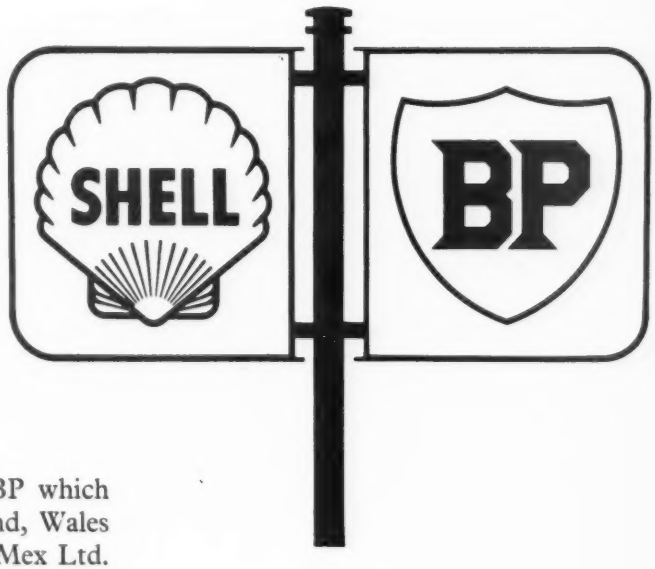

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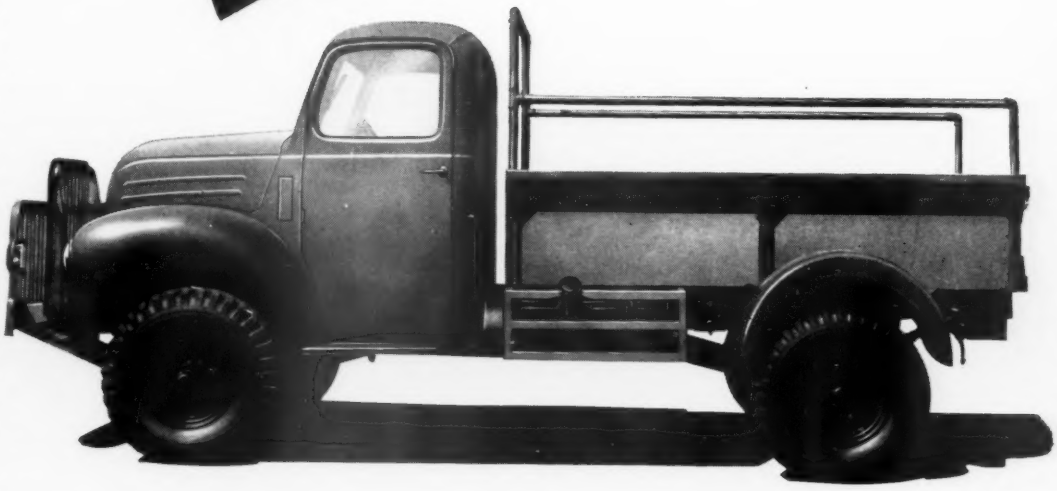

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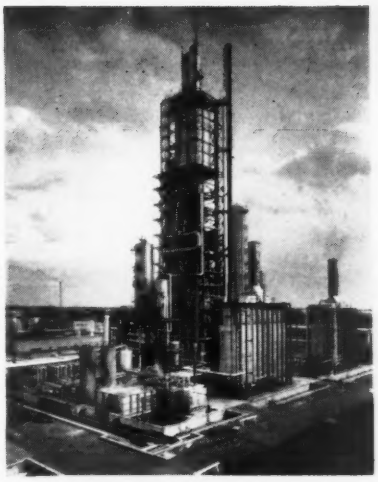

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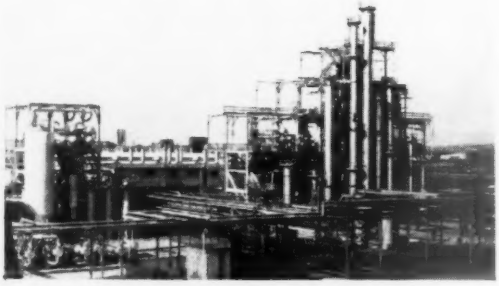

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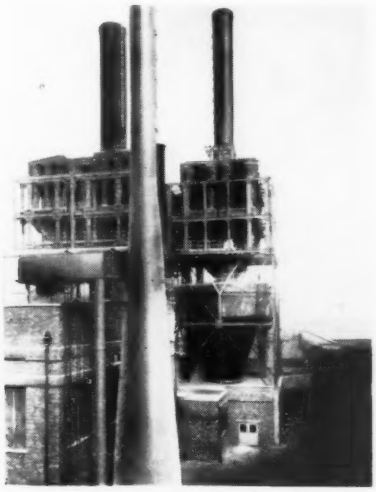

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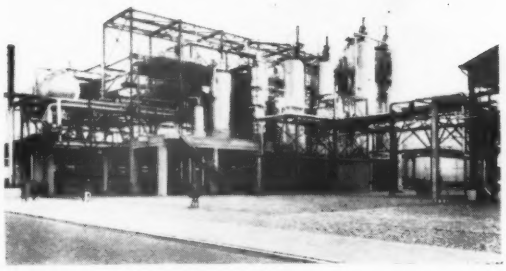

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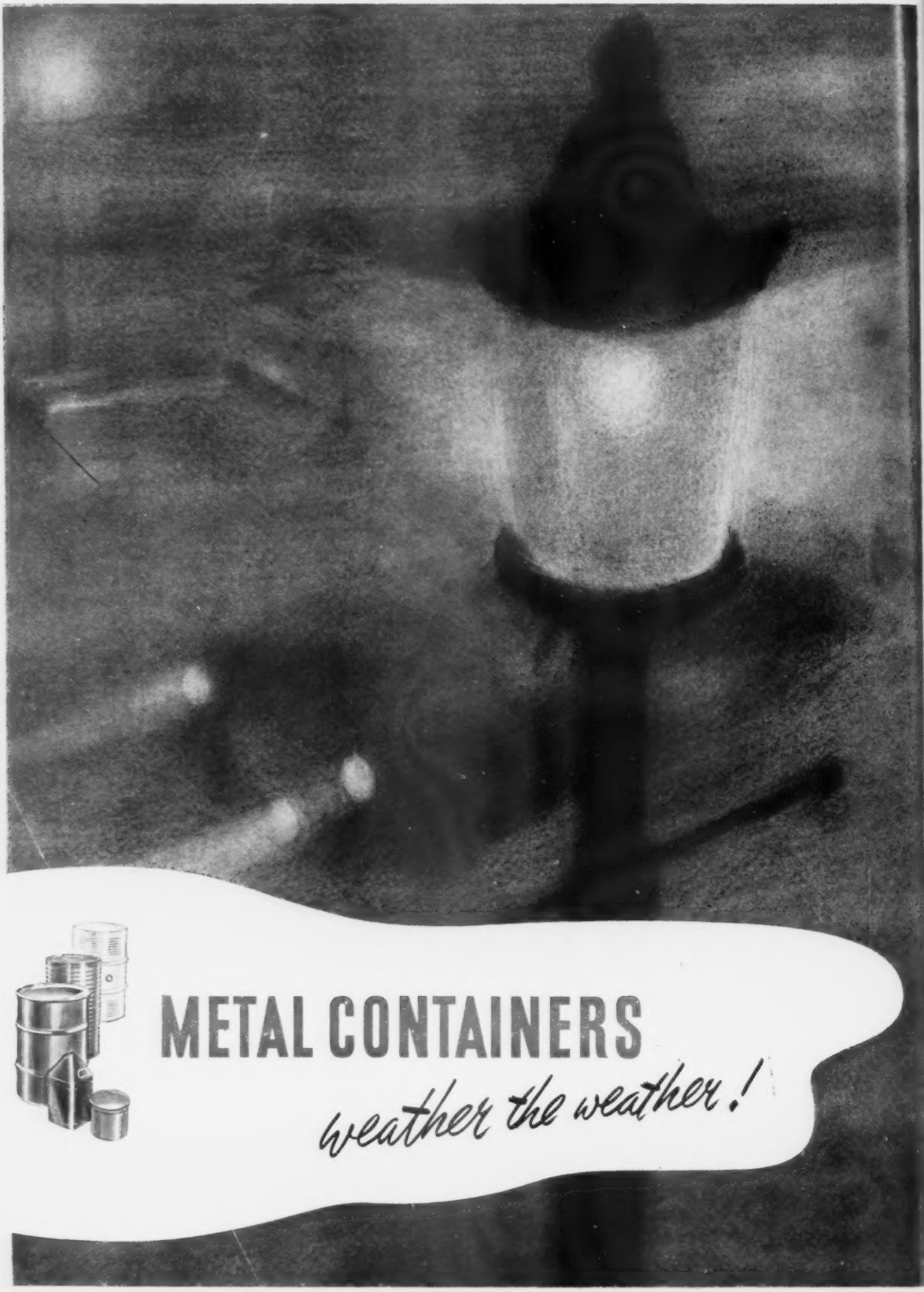

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